AD A119097

INTEGRATING ARMS LIMITATION AND DEFENSE PROCUREMENT PLANNING: THE IMPACT OF EMERGING TECHNOLOGIES (U)

SCIENCE APPLICATIONS, INC.
P.O. Box 1303
1710 Goodridge Drive
McLean, Virginia 22102

27 July 1981

Draft Final Report for the Period 9 June 1980 — 27 July 1981

CONTRACT No. DNA 001-80-C-0339

THIS WORK SPONSORED BY THE DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DoD) DARPA ORDER NO. 4033.

Prepared for

Director

DEFENSE NUCLEAR AGENCY

Washington, D.C. 20305

Monitored by

G. BUTLER

DARPA ORDER NO. 4033

PROGRAM CODE NO. 1E20

PROGRAM ELEMENT CODE 62301E

AMOUNT OF CONTRACT FUNDS SUPPORTING THIS TASK - $125,000

CONTRACT NO. DNA001-80-C-0339

PRINCIPAL INVESTIGATOR AND PHONE NO.

CHRISTOPHER J. MAKINS
703 - 827-4714

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A119097	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Integrating Arms Limitation and Defense Procurement Planning: The Impact of Emerging Technologies		5. TYPE OF REPORT & PERIOD COVERED Final 9 June 1980 - 27 July 1981
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) E.C.M. Higgins, C. J. Makins, M.G. Markoff, F. Melling, R.C. Molander, H. Stoertz		8. CONTRACT OR GRANT NUMBER(s) DNA001-80-C-0339
9. PERFORMING ORGANIZATION NAME AND ADDRESS Science Applications, Inc. P.O. Box 1303 1710 Goodridge Drive, McLean, VA 22102		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Program Code No. 1E20 Program Element Code 62301E
11. CONTROLLING OFFICE NAME AND ADDRESS Director Defense Nuclear Agency Washington, D.C. 20305		12. REPORT DATE 27 July 1981
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Mr. G. Butler Arms Control Support Group, Office of the Under Secretary of Defense for Research and Engineering The Pentagon, Washington, D.C.		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release, distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This work sponsored by the Defense Advanced Research Projects Agency (DOD)
DARPA Order No. 4033

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Arms Limitation
Arms Control
Defense Procurement
Defense Technology
Soviet Military Doctrine

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Arms limitation and defense procurement policies should be complementary means of achieving national security objectives. Past experience with arms limitation negotiations yields important lessons about the circumstances in which arms limitation agreements can be reached. Experience also suggests the need for an improved process of net strategic and technical assessment to evaluate possible arms limitation regimes.

(over)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

82 09 09 015

As part of this process the ways in which Soviet arms limitation and defense procurement policies are integrated need to be better understood. Soviet policy is heavily oriented towards the achievement of clear strategic objectives. But in a dynamic strategic relationship, several factors, including U.S. technological abilities, may make the Soviets calculate that arms limitations can serve those objectives.

Emerging technologies with defense applications can be classified in terms of their development difficulty, cost in terms of money and manpower and overall strategic impact. Twenty-two systems concepts using new technologies are identified which would be likely to have a major strategic impact if successfully deployed. Half of these involve space-based, directed energy weapons. The United States and the Soviet Union appear to be roughly equal in their mastery of the technologies required for such systems. Neither country has successfully built and tested such systems.

Arms limitation opportunities in the areas identified as of highest strategic significance are assessed on the assumption that no radical breakthrough in verification is achieved. Many areas are not suited to arms limitation. But those for which a good net strategic and technical assessment is required relate to ballistic missile defense, space-based weapons platforms and wide-area, active ASW surveillance systems. For all of these, a prima facie case can be made that a verifiable arms limitation agreement might be in the U.S. strategic interest.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

EXECUTIVE SUMMARY

INTRODUCTION

It has become a truism that arms limitation policy and defense planning should be complementary means to the overall objective of national security. But the practical application of this principle has not proved simple. However, short of a major increase in international tension, interest in, and political and international pressures for, consideration of various arms limitation possibilities will be a constant feature of the policy landscape in the United States. This will be true not least because of real resource constraints and the desirability of a measure of stability or at least predictability for defense planning purposes. The need for a better means of integrating arms limitation and procurement policies in long range defense planning will therefore remain pressing.

This study was conceived with this situation in mind. Its purpose is to survey with a broad brush the major emergent technologies with national security applications and to distill, in the light of historical experience with arms limitation efforts, the arms limitation questions and opportunities they present. Its concern is with arms limitations that would have some significant impact on the defense postures of the two sides, as opposed to those whose primary significance would be in the maintenance of a "process" or a broader relationship. Its focus is on the longer-term future 10-15 years from now and on some of the major strategic choices which are likely to have to be made in that time period, rather than on immediate negotiating situations and problems.

The study set out along three separate lines of enquiry. First, the modern history of arms limitation negotiations (notably SALT) was reviewed in an effort to derive lessons relevant to the future. Second, Soviet behavior in arms limitation negotiations and the

relationship between Soviet arms limitation and defense procurement policies were analyzed as a basis for trying to gauge likely Soviet responses to future developments both in military technology and arms limitation. Third, a wide field of emerging military technologies was surveyed and classified in terms of the strategic impact of their application and of their likely cost. On the basis of these analyses, the potential contribution of arms limitations to achieving U.S. strategic objectives was assessed in relation to a broad range of future weapons systems and a smaller number of critical areas was identified in which arms limitation policy and defense procurement planning need to be carefully integrated.

LESSONS FROM THE PAST AND MORALS FOR THE FUTURE

A number of representative cases or episodes of special relevance were briefly surveyed on the basis of readily available sources and the direct experience of selected individuals. The cases chosen were MIRV, ABM, cruise missiles, European theater arms limitation and CW. These cases were used to establish preliminary hypotheses about the arms limitation/defense procurement planning relationship which could form a basis for evaluating future possibilities. Three aspects of the process by which the United States and the Soviet Union develop new technologies for military application were identified as being critical to the arms limitation/defense procurement planning relationship. These were taken as the foundations for the three following hypotheses, which proved to be of importance throughout the study.

> Application Diversity: some technologies are so multifaceted and broad in appeal that the strategic and bureaucratic momentum behind their application is hard to slow. Thus even though attractive arms limitation bargains covering certain applications of a given technology might be formulated, they could fail to be adopted because of a fear either of circumvention (because the bargains did not extend to cover the full range of potential applications of that technology) or of spillover (onto other applications of the technology on which limitations were strategically undesirable).

Technological Momentum: applications which require relatively little further advance in technology development and towards which development is progressing smoothly and rapidly are relatively difficult to slow or stop by arms limitation negotiation and agreement. By contrast, those applications for which the additional development required before successful deployment is relatively great and the momentum of the development is relatively low, whether due to technical difficulty in the development or to budgetary restraints, are more likely to be suitable candidates for successful--and mutually advantageous--arms limitations.

Technological Asymmetry: advantage can be derived in arms limitation negotiations by the side that has a real or perceived technological lead in a vital area. However that advantage can normally not be applied to situations in which an agreement would in effect freeze the other side out of a technology application which its rival was close to being able to deploy and could, if necessary, deploy covertly to achieve a strategic advantage through breakout. A corollary of this is that there may be "time windows" in the development cycle of systems involving the application of new technologies during which arms limitation agreements based on prohibitions on development, as opposed to quantitative limits on deployment, may be possible, in the sense that neither side is yet the master of one or more of the relevant technologies.

The study of the five cases yielded some important perspectives for the subsequent analysis of future arms limitation opportunities:

1. The interactions between national strategy, international relationships and arms limitation are of critical significance. Where national objectives are indeterminate, inconsistent or subject to frequent or rapid change, the use of arms limitation -- or any other means of policy -- is likely at times to prove unsuccessful and even self-defeating. The lesson of the experience of the 1970s is that analysis of future arms limitation possibilities must be based on precise and explicit assumptions concerning both U.S. and Soviet strategic concepts, objectives and policies. The question for analysis is whether either side, or both, in the light of their assumed, different strategic objectives and policies would be likely to see advantage in the proposal. It is a matter of policy decision as to whether to accept the assumptions on which the analysis rests. The ABM Treaty case was especially instructive on this point and is a good point of reference in connection with the prospects for both BMD limitation and arms limitations in other areas.

2. The disparity between the inherently dynamic nature of the East-West military and technological competition and the relatively static nature of arms limitation agreements is an important one. While such agreements can be changed, this can by and large only be done with some difficulty. But if such agreements are not of some significant duration, they are likely to have little certain practical impact on the course of the strategic competition.

3. There are time periods -- or "windows" -- within which attempts to negotiate arms limitations in the form of the prohibition or effective prohibition of new technology applications which may be assessed as being in the U.S. national security interest have the greatest chance of being successful. These time windows are defined by the three factors cited earlier, namely, technological asymmetry, technological momentum and application diversity. Typically, there would be two such windows in the lifetime of a particular technology or systems concept during which prohibitions or significant limitations could be achieved.

   The first window would open after development had proceeded successfully to the point at which the characteristics of the system were clearly enough defined to permit its strategic significance to be gauged and a detailed assessment of arms limitation possibilities to be made, but before either side's development program had reached the point at which one side, but not the other, was ready to produce and deploy the system. This window might in some cases be open for a long time, e.g., when a development program makes little headway or stalls, due either to inability to solve a technical challenge (e.g., ABM in the 1960s/early 1970s) or lack of military interest/financial support (cruise missiles in the early 70s). But in other cases, this window may only open extremely briefly, as was the case with MIRV, which moved quickly through a successful development program to a point at which the system was ready to be deployed.

   The second window would open after both sides have mastered the technology, but before full-scale deployment has been completed. Since at this point the military demand for the system would generally be real, the most likely arms limitation options would be for fairly permissive numerical limitations on deployments, though stricter limits, effective prohibitions or even complete prohibitions would still theoretically be possible.

4. A thorough process of net strategic and technical assessment is essential to the evaluation of arms limitation possibilities. This process would be both conceptually and bureaucratically more balanced than the existing arms control impact statement process and would, in addition, represent a vehicle for gauging both arms limitation proposals and defense procurements in relation to the statement of national strategy and objectives contained in the Defense Guidance document. The process would involve the use of various techniques of analysis and technology forecasting to define and evaluate, in the light of specified U.S. and Soviet strategic objectives, the U.S./Soviet strategic relationships which would occur at different times in the future and under different arms limitation regimes (including a no-arms limitation regime). The cases studied suggested that the absence of such an assessment in the past was a distinct liability.

THE SOVIET ARMS LIMITATION/DEFENSE PROCUREMENT PLANNING SYNTHESIS

The study uses three distinct modes of enquiry to provide perspectives on Soviet arms limitation and defense procurement planning. It (1) examines the policy context and doctrinal imperatives which currently shape Soviet force structure objectives and, in turn, constrain the potential for limitations on emerging weapons-related technology; (2) attempts to illuminate essential attributes of the decision-making process in the Soviet Union which reconciles questions of limitation with exploitation of weapons technology; (3) provides several case study examples which illustrate Soviet arms limitation behavior and some general hypotheses about the conditions under which the Soviets will agree to or reject limitations on technology; (4) reviews a number of emerging weapons technology areas to assess potential Soviet incentives for their limitation or their exploitation.

Despite the predominant influence of military considerations on Soviet policy, the distinctive Soviet strategic doctrine and the absence of any strong Soviet bureaucratic or public constituency for arms limitation, there are circumstances in which the Soviets might conclude that their own strategic objectives would be best served by arms

limitation agreements. Fear of the U.S. technological challenge and resource allocation problems are probably influential factors in Soviet calculations (as they appear to have been in Soviet acceptance of the ABM Treaty). For the future, the major Soviet strategic objectives are likely to be: accomplishing countermilitary missions; enhancing force survivability; increasing operational flexibility; and maximizing damage-limiting potential. Several potential new technology applications could present the Soviets with difficult choices as to whether these objectives would on balance be better served by unfettered competition with the United States or the achievement of equitable arms limitation agreements. Among the areas in which the Soviets may have to make such trade-offs are ballistic missile defense, the deployment of mobile ICBMs, ASW, space warfare capabilities, and aerodynamic forces.

The calculations the Soviets must make in order to make judgements as to where their interests lie in these areas are by no means simple ones with obvious answers. They require trade-offs between different objectives no less complex and difficult than those which are familiar in the United States.

THE POTENTIAL STRATEGIC IMPACT OF DEVELOPING TECHNOLOGIES

Developing military technologies were assessed in a structure designed to illuminate their likely strategic impact should their potential be carried to full technical and operational maturity. The assessment focussed on military <u>systems</u> which can have a substantial impact on the strategic future, and included the technological, developmental, and cost factors which appear to make some potential systems highly significant and others less so. A weapons system framework rather than a pure technology framework was selected for two primary reasons: (1) the strategic future will be impacted by weapon system applications of several different technologies, not by single technological breakthroughs; and (2) arms limitation negotiations are much more likely to be concerned with limiting specific systems than with constraining development of individual technologies.

The results of the detailed survey of emerging military systems and technologies are displayed in Tables 4.1 to 4.5 of the study, which cover ballistic missile defense systems, offensive nuclear strike systems, air/cruise missile defense systems, space warfare systems, and anti-submarine warfare systems. Although other areas (including technologies relevant to general purpose force operations) were included at the outset, the final phase of the study focussed on the five areas mentioned, which emerged as clearly the most important for the study's purposes. All the systems were assessed in relation to the technologies involved in their successful development, the critical factors controlling their development, the degree of R & D interest in them in the United States and the Soviet Union, and their overall cost and impact on the strategic relationship.

Twenty-two of the systems reviewed were identified as having the potential, if brought successfully through development to deployment, of creating a major impact on the future strategic relationship or on future procurement needs. These systems, which range across all the five major areas studied, are listed in Table 4.6, on page 4-30 and are briefly summarized in the facing table.

An important relationship observable in the table is that, of those few systems judged to have the potential for requiring a change in the nature of strategic forces, about half involve space-based, directed energy weapons. Not observable in the table is the fact that essentially the same weapon system in space can be designed for multiple-kill ASAT, wide area BMD, and even for wide area air defenses. The major differences among these applications are the number of stations required, ranging from only a handful for effective ASAT to a hundred or more for BMD.

The development difficulty and costs for such systems are formidable both for the United States and the Soviet Union. But the technology, at least for space laser systems, now appears to be

Summary of Systems with Potential for Major Impact on the U.S./Soviet Strategic Relationship and Procurement Needs

Systems Involving Relatively Minor Operational & Technical Risk

1.2	Tactical ballistic missile defenses
1.3	BMD, Atmospheric intercept for City/ICBM field defense (very high cost)
2.1-2.3	Advanced IC/IR/SLBM, very high accuracy; high penetrability vs. BMD; mobile basing for high PLS
3.3	Advanced fleet air defense systems
4.1	ASAT, Missile, ground or air launched
4.2	ASAT, Space mines
4.3	ASAT, Disabling by EW

Systems Presenting Major Countermeasure Risks

1.4,1.5	BMD, Exo-atmospheric intercept, City/ICBM field defense; BMD, Area defense, ground-based, capable against exo-penaids.
3.1	Advanced Nation wide air defense systems (including look down/shoot-down)
5.2-5.7	ASW Systems (fixed area surveillance-passive; mobile area surveillance arrays; fixed area surveillance-active; airborne surveillance and ASW weapons systems; satellite detection systems; SSBN trailing systems)

Systems Combining High Technological Risk, Countermeasure Problems and High Cost

1.6	BMD, Area defense, space based
3.4	"Exotic" air defense kill mechanisms
4.4	ASAT, space-based laser
4.5	ASAT, space-based particle beam weapons

NOTE: The numbers which precede the systems indicate their positions in Tables 4.1-4.5 and are included here for ease of reference.

manageable, given sufficient application of resources. Further, the United States and the Soviet Union appear to be roughly equal in their mastery of the technologies required for such systems, with the United States ahead in some respects, such as information management and guidance/control, while the Soviet Union may be ahead in others, such as beam power generation. Neither country has successfully built and tested such a system. But both may be close to the capability for undertaking such a project.

THE ARMS LIMITATION ARMOURY

The analysis of the potential for an arms limitation contribution to specific defense problems in the five critical technological areas was performed with particular attention to the relevance of the hypotheses advanced earlier. Two other "lessons learned" from arms limitation negotiations to date were also used as a basis for the analysis:

1. Neither side should count on being able to use arms limitation negotiations as a means of gaining significant military advantage over the other. Rather, arms limitation opportunities are most likely to exist where a particular limitation is to the mutual advantage of both sides or where a particular limitation contributes to the solution of a problem unique to one side and can be balanced by a comparable limitation which contributes to the solution of a problem unique to the other.

2. Revolutionary changes in the technical means of verification or the level of intrusiveness are most unlikely to be possible in the time frame under consideration in this study -- although some change in both these realms can be expected. Thus the assessment focused on limitations designed to be adequately verifiable at either: (1) the level of "intrusiveness" sanctioned in the SALT I and proposed SALT II agreements, or (2) the next step of intrusiveness which might be negotiated as part of a future arms control agreement (e.g., on-site black boxes at test sites, controlled overflight by aircraft, limited on-site inspection as part of a sampling scheme, ban on telemetry encryption, etc.).

The principal areas which emerged from the study in which some arms limitation measures might be of advantage to the United States were:

1. BMD Systems:

(a) At present, there is substantial technological momentum in the United States in site defense BMD technology. The Soviet Union would appear to lag the United States in this area, but it seems clear that current U.S. hard-site defense technology is not far beyond the reach of the Soviets. Thus the technology asymmetry would not seem to be severe at present. It remains to be seen whether the current momentum in hard-site defense technology can be translated into a workable system, since a number of formidable technical problems remain to be overcome. There is little applications diversity in 'classical' BMD technology (i.e., of the kind limited in the ABM Treaty), although this is changing somewhat with the nascent interest in ATBM and BMD for ships. The question whether a relaxation of the ABM Treaty limits to permit site defense would be in the U.S. interest raises complex issues which require a highly challenging net strategic and technical assessment.

(b) At present there is no technological momentum and essentially no technological asymmetry in BMD systems for atmospheric intercept at city or ICBM field range. As a consequence there is little pressure against maintaining the current ABM Treaty restrictions on such systems.

(c) There is at present little technological momentum in development of an exo-atmospheric overlay to a site defense system. There is probably some technological asymmetry favoring the United States, in light of the advanced exo-atmospheric sensor program. But the ease of developing countermeasures against such a capability makes the current technological asymmetry unimportant in view of the difficulty of developing a system effective against potential countermeasures. As a consequence, there is currently little reason not to maintain the ABM Treaty ban on exo-atmospheric defense at city or ICBM field ranges.

(d) The arguments against modifications to the ABM Treaty to permit ground-based area defenses are the same as those cited above for city and ICBM field range defenses. However, Soviet interest in seeking such modifications might prove greater than that of the United States because of their concern about third party threats.

(e) In spite of much speculation about the future of space-based BMD systems using laser or particle beam kill mechanisms, the rate of progress in the development of such systems is slow and speeding it up would be extremely expensive. At present, there is little confidence that space-based BMD systems can be deployed before the year 2000, even with greatly accelerated development efforts. And, even then, if the enormous technological problems are resolved, an effective BMD system would cost at least one hundred billion, and perhaps several hundreds of billions of dollars. Thus, the situation is potentially favorable to the maintenance of the current ABM Treaty ban on "exotic" BMD systems. On the other hand, laser and particle beam weapons in space form a realm of broad application diversity, which will probably stimulate activity and resource commitments for purposes other than BMD. If these development efforts are undertaken and prove successful, verifiable limits on BMD would be greatly complicated, particularly if deployment of space-based air defense and/or ASAT were allowed to proceed. Even so, adequately verifiable limits might still be possible for space based BMD systems because of the extensive testing, the relatively high orbits, and the relatively large number of stations required for effective wide area BMD coverage. In any such regime, however, the BMD breakout potential would be great.

2. Offensive Nuclear Strike Systems. Near-zero CEP ballistic missile systems constitute an area in which there is at present little technological asymmetry or technological momentum. A competition in this area would probably quickly produce such an asymmetry favoring the United States. But the possible Soviet interest in attacking the MX system in some possible basing modes with smaller, more accurate RVs could make any U.S. victory in the technological competition a pyrrhic one. Although arms limitations on systems for correcting boost phase errors (e.g., GPS) are probably not possible, a sound argument can be made, in the context of a continuing, restrictive ABM Treaty, for a "wait and see" ban on small high beta RVs and a parallel ban on the further testing of MaRVs.

   In the area of air-breathing vehicles for high AAW penetrability, the lack of technological momentum and technological asymmetry make a ban on MIRVed cruise missiles an acceptable arms limitation option for the United States, though one with little impact on U.S. procurement policy or the strategic relationship (since proliferation of cruise missiles appears to be a preferable means of insuring

penetration of air defenses). Thus a prohibition of MIRVed cruise missiles for some non-military or bargaining reason (as occurred in SALT II) would be of little concern because of the marginal interest in such systems.

3. Space Warfare Systems. This area is one which raises the most complex strategic and practical considerations. The distinct U.S. advantage in the exploitation of space and the relatively greater U.S. dependence on space-based platforms for military applications suggest a strong U.S. interest in limitations on ASAT systems, though with some qualifications (e.g., concerning the Navy's interest in defeating Soviet ocean surveillance systems). While the Soviet Union has been reluctant to talk seriously about a ban on ASAT missile systems, in part, probably, because of its current advantage in this area, the Soviets may calculate that this is an area in which the United States could quickly equal and surpass them, with consequent risk to their own growing dependence on space-based systems. Moreover, the strategic implications of war in space have as yet been poorly assessed, certainly in the United States and perhaps also in the Soviet Union.

   In the technology area, several elements must be considered. Some potential technologies, such as ASAT space mines or ASAT systems using electronic disabling mechanisms, seem ill-suited to arms limitations either because of verification and definition problems or because any limitations in peacetime would be militarily insignificant. Others, like ground- or air-launched ASAT missiles, space-based laser or particle beam ASAT or ground- or air-based laser ASAT are better suited to an arms limitation approach and show varying degrees of technological momentum and technological asymmetry as between the two superpowers at present. In general, however, neither side has as yet made significant advances towards a capability to operate against all types, or even large numbers, of satellites. This fact, and the differing requirements (in terms, especially, of numbers of systems) for different applications (ASAT, BMD, AAW), open up a range of possible arms limitation opportunities.

   The complexity of the strategic and technical issues involved makes this an area which urgently requires a detailed net assessment of U.S. strategic objectives and alternative arms limitation regimes.

4. ASW Systems. There is modest but significant technological momentum in most aspects of ASW on both sides. On virtually all aspects of ASW there currently exists a distinct

technological asymmetry favoring the United States, which has had a substantial lead in this field for years -- and is likely to maintain it. At the same time, there is clear applications diversity between strategic and broad tactical applications for ASW in protecting sea lines of communication and battle groups, interdicting enemy forces, intelligence collection, etc. The sum of these factors makes ASW a realm in which U.S. security is in general unlikely to be enhanced by arms limitations (though there might be specific limitations that would be of interest for cost or other reasons) and which is, in any case, not especially propitious for arms limitation. The principal area in which an arms limitation approach affecting a particular technology application deserves closer investigation is that of fixed active area surveillance systems. Since these could be readily identified and their power outputs measured, limitations on such systems, perhaps by the exclusion of certain regions, could presumably be adequately verified. In terms of the hypotheses previously put forward, this is an area suitable for arms limitation. Neither side would appear to have a technical advantage at present and a competition in such systems would not obviously be to the advantage of either.

It was not possible within the scope of the study to explore in detail the various areas in which the preceding analysis yielded a case for believing that arms limitations might be both feasible, in the light of past experience and the best available understanding of the Soviet calculus affecting arms limitations, and also supportive of U.S. strategic objectives. Of the several such areas which came to light, the most promising for further analysis and the most important in terms of U.S. interests is undoubtedly that of space-based weapons platforms and related areas (such as ground-based ASAT launchers).

1.0 INTRODUCTION

It has become a truism that arms limitation policy and defense planning should be complementary means to the overall objective of national security. But the practical application of this principle has not proved simple. So much so that the debate about arms limitation policy has become increasingly polarized, with one side inclined to see arms limitation as the enemy of a sound national defense posture and the other prone to argue that the defense establishment has been allowed to undermine promising opportunities for militarily useful arms limitations for no good national security reason.

Short of a major increase in international tension, interest in, and political and international pressures for, consideration of various arms limitation possibilities will be a constant feature of the policy landscape in the United States. Not only will this interest derive from the traditional "arms control" constituency, but it will also be felt from within a defense establishment compelled to live with real resource constraints and anxious to achieve a measure of stability or at least predictability in the background against which it must plan. The issue of finding a complementary relationship between arms limitation policy and defense planning will therefore remain a live one.

This study was conceived with this situation in mind. Its goal was to distill from the mass of debate that has swirled around this general subject for some time practical lessons and options which the United States could try to exploit in the future. Its focus is on the major emergent technologies for application to national security and the arms limitation questions and opportunities they present. It does not, therefore, deal with a wide range of important questions which affect the broad relationship between arms limitation policy and defense planning. It does not consider the broader context of inter-

national affairs within which negotiated arms limitations must be considered*, *except where this is relevant to specific topics under* discussion. Its concern is with arms limitations that would have some significant impact on the defense postures of the two sides, as opposed to those whose significance would be in the maintenance, for other purposes, of a "process" or a broader relationship. Nor, with a similar exception, does it deal in detail with types of arms limitation, such as manpower limits or general confidence building measures, which have little or no impact on defense procurement policy and planning. Rather, it is primarily concerned with issues raised by technologies in terms of their narrow impact on force relationships and the types of arms limitation policies which might be devised to limit or control that impact. Nor, finally, does it deal specifically with short-term or essentially tactical questions about how to handle the present negotiating situation in START or the long-range INF negotiations. Rather it looks to a longer-term future 10-15 years from now and to some of the major strategic choices which are likely to have to be made in that time period.

Even with these qualifications, the task implied by the study's scope was a substantial one. Within limitations of time and resources it was not possible to explore in great detail the options and opportunities suggested here. What has been attempted is to set up an overall framework within which to address these problems, to identify those which are likely to have the most profound impact on the nation's security in the coming years and to outline how and why some of these might lend themselves to arms limitation treatment in the best interests of US national security.

*For a useful discussion of this subject see Barry M. Blechman: "Do Negotiated Arms Limitations Have a Future?" in Foreign Affairs, Fall 1980, pp. 102-125. See especially pp. 106ff.

To achieve these goals, the study set out along three separate lines of enquiry. First, the modern history of arms limitation negotiations (notably SALT) was reviewed in an effort to derive lessons potentially applicable to the problem at hand. Second, Soviet behavior in arms limitation negotiations and the relationship between Soviet arms limitation and defense procurement policies were analyzed as a basis for trying to gauge likely Soviet responses to future developments both in military technology and arms limitation. Thirdly, emerging military technologies were surveyed and classified in terms of the strategic impact of their application and of cost. On the basis of the results of these analyses, a small number of critical areas for arms limitation policy were identified and studied in more detail.

Many persons have made extensive contributions to this study and no attempt is made to identify them all here. The principal authors of the report were, in alphabetical order, Michael Higgins, Christopher Makins, Michele Markoff, Philip Melling and Roger Molander. Howard Stoertz and John Yochelson, both SAI consultants, also made important contributions to writing the report.

2.0 INTEGRATING ARMS LIMITATION AND DEFENSE PROCUREMENT PLANNING

2.1 LESSONS FROM THE PAST

A widespread belief has developed that the complementarity of arms limitation and defense procurement policies as means of achieving national security, however widely accepted in principle, has been poorly reflected in US policy during the period of major arms limitation negotiations since the beginning of SALT. In assessing the future relationship between these two aspects of policy, it is essential to take explicit account of the history from which observers have derived widely divergent conclusions, while recognizing that few uncontroversial lessons can be drawn from it.

A definitive study of this subject would involve a substantial effort of research into the actual negotiating records and related government documents, some of the more important of which may be still unavailable or fragmentary, and into the interplay between individuals and organizations in the decision-making process. Such a major research effort lay outside the scope of this study. For present purposes, therefore, it was decided to select a small number of representative cases or episodes which seemed of special relevance and to survey them briefly on the basis of readily available sources and the direct experience of selected individuals involved in the negotiating and decision-making processes. These cases could then be used to establish preliminary hypotheses about the arms limitation/defense procurement planning relationship which could form a basis for evaluating future possibilities.

In reviewing the history of arms limitation efforts, it quickly became apparent that the bulk of the experience relevant to the purposes of this study lay in the area of strategic nuclear arms limitations. The main cases chosen, therefore, were in this area. While negotiations and proposals for arms limitation in Central Europe and naval arms limitations and for arms limitation affecting other military

forces are obviously of some relevance, they have not, by and large, yielded a great body of experience about the impact of arms limitations on defense procurement planning and the application of new technology to defense purposes. The experience of arms limitations in Europe is, however, included in the cases reviewed in order to highlight the special features of any attempt to negotiate limitations on general purpose forces.

The cases selected for review were MIRV, ABM, Cruise Missiles, European theater arms limitation, and Chemical Warfare. In each case, the approach taken was to review the chronology of events and subsequently to analyze them in relation to the purpose of the study. Appendix A contains the outline of the chronologies of each of the cases chosen. The following sections contain a brief commentary on each case and some of the lessons to be learned from each.

2.2 FIVE CASES

2.2.1 Introduction

In reviewing the cases chosen, three aspects of the process by which the United States and the Soviet Union develop new technologies for military application were of particular concern. It will be useful to review them in turn before addressing the cases themselves.

The first important aspect was the question of the singularity or diversity of the applications to which a given technology or group of technologies are potentially relevant. The importance of this question to potential arms limitations has been admirably summarized by Dr. Herbert York.* York distinguishes between two kinds of technologies: first, those which are "too diffuse, too protean, too difficult to define and delimit to be stopped by confrontation. They can

*See his article "Multiple Warhead Missiles" in Scientific American, November 1973 (Volume 229, Number 5).

only be stopped by slowing or stopping the arms race as a whole"; and, secondly, those which are "addressed to a clearly evident and single purpose and depend on what might be called a unitary decision-making process. In principle they can be stopped by direct confrontation". This distinction suggests a hypothesis of application diversity, namely that some technologies are so multifaceted and broad in appeal that the strategic and bureaucratic momentum behind their application is hard to slow. Thus even though attractive arms limitation bargains covering certain applications of a given technology might be formulated, they could fail to be adopted because of a fear either of circumvention because the bargains did not extend to cover the full range of potential applications of that technology or of strategically undesirable spillover (onto other applications of the technology on which limitations were not imposed).

A second important aspect of the technology development process for the purpose of this study was the relationship at any given time between the momentum of development of particular technologies for military applications and the level of development required for the application to be effective. A hypothesis concerning technological momentum would be that applications which require relatively little further advance in technology development and towards which development is progressing smoothly and rapidly would be relatively difficult to slow or stop by arms limitation negotiation and agreement. This would be both because the negotiations and agreement would be likely to be overtaken by the successful completion of the technology development and because the temptation on one side or the other to try to derive strategic advantage from the application would be relatively high. By contrast, those applications for which the additional development required before successful deployment is relatively great and the momentum of the development is relatively low, whether due to technical difficulty in the development or to budgetary restraints, would be more likely to be suitable candidates for successful -- and mutually ad

vantageous -- arms limitations. This hypothesis is illustrated graphically in Figures 2.1 and 2.2, which show, respectively, a case in which technological momentum is so high that successful arms limitation is unlikely and one in which technological momentum is so low that successful arms limitation is more likely.

A third important aspect of the technology development process which was a focus of interest in reviewing the case studies was the relative positions -- and perceptions of those positions -- of the United States and the Soviet Union in the development of given applications of new technologies. Two aspects of this issue seemed prima facie important. First, the incentive which a degree of perceived technological asymmetry between the two sides could create for the less advanced side to accept a negotiated arms limitation agreement which placed effective limitations on the ability of the more advanced side to derive strategic advantage from its technological lead. Secondly, the disincentive which the less advanced side might feel to enter into an agreement which threatened to have the effect of leaving the more advanced side with a capability -- or near capability -- to derive strategic advantage from the deployment of an application of new technologies, while in effect condemning itself to a permanent inability to develop systems for the same application. This latter point would obviously be of special relevance in connection with applications before the deployment of which extensive and visible testing is needed and for which, therefore, limitations on testing would be especially constraining.* A hypothesis concerning technological asymmetry would therefore be that the negotiating advantage that one side can derive

*The study accepted as a premise that arms limitation cannot be expected in the foreseeable future to control the R&D process itself. Therefore no agreement is likely to deflect the development of any technology which is central to the achievement by one or the other superpower of a major objective of its military doctrine or policy. But this need not, of course, mean that no limitations can be placed on the application of that technology if its introduction by both sides would have, on balance, undesirable -- or excessively speculative -- consequences for both.

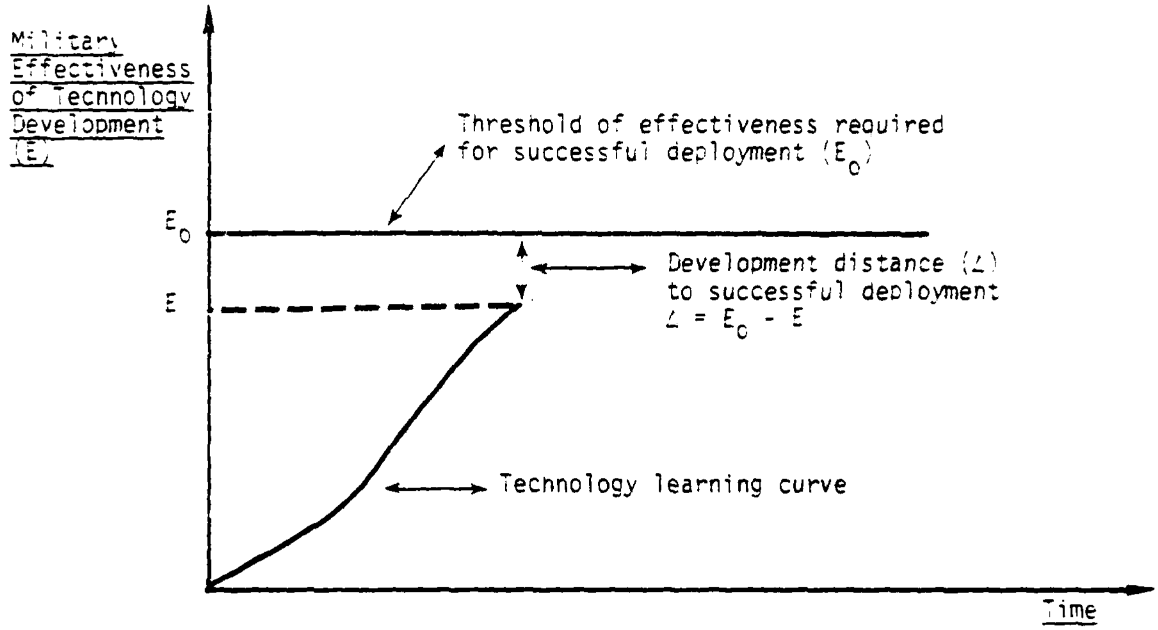

Figure 2.1: Technological Momentum Hypothesis: Case A: $\angle$ to successful deployment low, rate of progress on learning curve high.

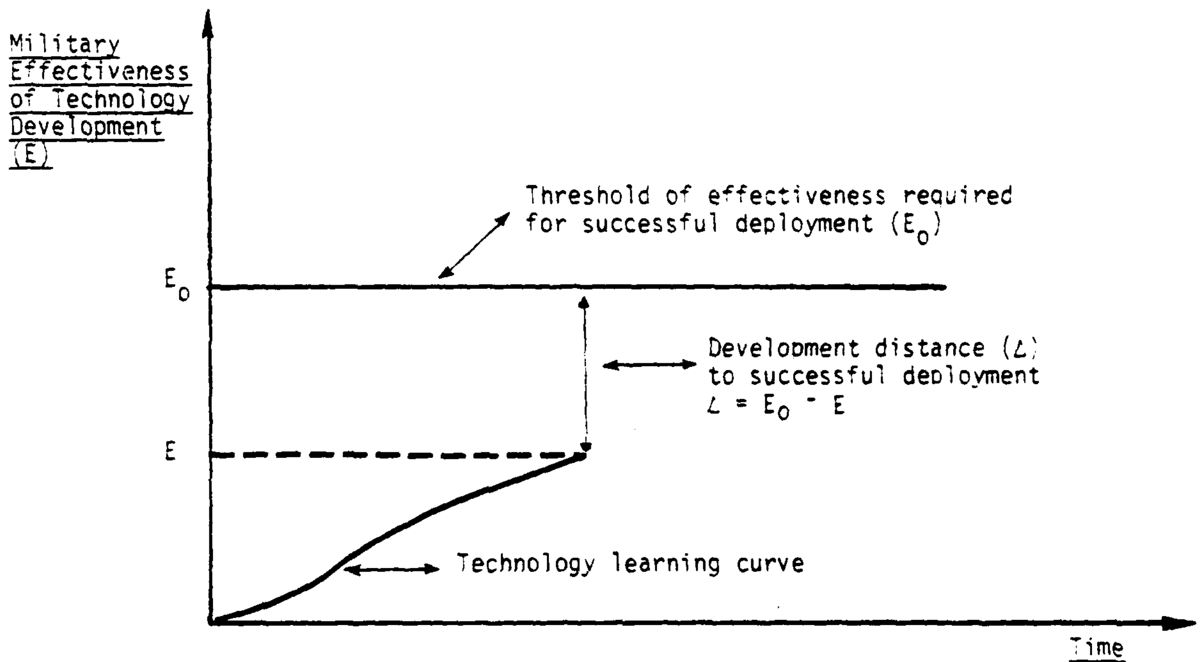

Figure 2.2: Technological Momentum Hypothesis: Case B: $\angle$ to successful deployment high, rate of progress on learning curve low.

from a technological asymmetry can normally not be applied to situations in which an agreement would in effect freeze the other side out of a technology application which its rival was close to being able to deploy and could, if necessary, deploy covertly to achieve a strategic advantage through breakout. A corollary of this is that there may be "time windows" in the development cycle of systems involving the application of new technologies during which arms limitation agreements based on prohibitions on development, as opposed to quantitative limits on deployment, may be possible, in the sense that neither side is yet the master of one or more of the relevant technologies.

These three aspects of the technological development process in the United States and the Soviet Union proved to be important not only to the reviews of the five cases studied, but also to the analysis of Soviet arms limitation and defense procurement planning policies and to the analysis and assessment of arms limitation opportunities which future technological developments might create. They will therefore recur as leitmotivs throughout this study.

2.2.2 MIRV

The emergence of MIRVs was a seminal development in the evolving US/Soviet strategic relationship in at least three important respects.

First, MIRV deployment was seen in the US in the late 1960s as the most effective, and politically and economically the most affordable, offset to anticipated unrestrained Soviet ABM deployment in the early 1970s. In an era of tight budgets, in comparison to increasing the numbers of US strategic missile launchers, MIRVs were relatively uncontentious politically and a relatively inexpensive means of insuring penetration of Soviet defenses (as well as generally multiplying US striking power).

Secondly, MIRV was a prime area of US technological lead. This in itself created an incentive to exploit the advantage by deploying MIRVed launchers at a time at which the inevitability of strategic parity was widely accepted intellectually, but still not fully assimilated psychologically, politically and bureaucratically in the United States.

Thirdly, the development of MIRVs threatened the survivability of fixed land-based ICBMs in a way most unsettling to the future strategic balance by permitting, at least in theory, the destruction of the enemy's fixed ICBM force with a favorable RV exchange ratio. However, the prospect of the vulnerability of the US ICBM force to a Soviet first strike using MIRVed ICBMs was by no means uniformly accepted as a serious problem within the U.S. defense establishment in the late 1960s and early 1970s. Even when the issue was raised, it was argued by many military planners that the problems of attack sequencing, the dangers of fratricide, and the uncertainties in missile accuracy would make the success of such an attack appear highly doubtful to Soviet decision makers.

The negotiation of limitations on offensive capabilities was one obvious way of inhibiting these changes in the U.S.-Soviet strategic relationship, although it was by no means generally accepted as likely to prove fruitful or desirable, particularly in the case of such an attractive multipurpose technology as MIRV. However, a MIRV test, production and deployment ban did represent an arms limitation option. Indeed, it was probably the most persuasive quid pro quo the United States could offer in exchange for stringent and comprehensive limitations not only on ABMs, but, more especially, on intercontinental offensive systems in SALT I.

There was a sizable constituency in the Department of State, ACDA, and Congress (cf. MIRV ban initiatives in the House of Representatives in the summer of 1969 and Senator Humphrey's letter of August 1969

to Secretary of State Rogers) in favor of a U.S. MIRV ban proposal. By contrast, the idea encountered opposition among the Armed Services, OSD and in the White House. Nevertheless, the Administration did in the event propose a MIRV test and deployment ban, conditional upon on-site inspection, to the Soviets as a SALT option in April 1970.

Most analysts have questioned the seriousness of the U.S. MIRV ban proposal, not least because of the timing of its submission, less than two months before Minuteman III deployment was scheduled to -- and did in fact -- begin.* Some accounts even suggest that the wide-ranging on-site inspection condition was added at JCS insistence mainly so as to ensure that the proposal would be rejected by the U.S.S.R. Predictably, the Soviet counterproposal -- a MIRV production and deployment ban, the seriousness of which was also highly questionable -- rejected this element, as well as the test ban. In any case, the speed (within three months) with which the proposal was dropped reflected the lack of deep commitment to the idea. It would have been an extraordinarily bold and ambitious move in a new realm, arms limitation, which at the time was under suspicion as to its utility as a vehicle for solving military problems.

There is no assurance that an acceptable agreement on a MIRV test and deployment ban could have been negotiated as part of a broader SALT I package involving ABM limitations and more stringent restrictions on intercontinental offensive systems. The concept of a MIRV ban was, indeed, fraught with problems. A ban on testing would essentially have frozen the United States in a position of technological superiority. Although this superiority would not have been exploitable under a

*For a detailed and balanced account of the history of MIRV ban proposals at this period from a committed proponent of a ban, see Gerard C. Smith's Doubletalk: The Story of SALT I, Chapter 6. Smith is categorical in his view that "A MIRVless world would have much safer" than the one which has developed. But he is scrupulously fair in his judgments about the chances of achieving a MIRV ban: "While there may have been an opportunity missed, it was not a clear one." Ibid, p. 154.

MIRV ban, it was clearly a major impediment to Soviet acceptance of such a ban, possibly because of Soviet fears of a U.S. "breakout" capability. Likewise, the question whether on-site inspection of a MIRV test/deployment ban was necessary was not an easy one.

Nor is it entirely clear what the long-term consequences of such a MIRV ban would have been for the balance of strategic power. It would certainly have slowed the growth of the "warhead affluence" which both sides developed in the 1970s and reduced the specter of first strikes against land-based targets at favorable exchange ratios. It would also have made it harder for the United States to place much greater reliance on the sea-based force. What is clear is that the idea of a MIRV ban was an arms limitation option which, more than any other raised in SALT, except perhaps the ABM agreement, could have had a major impact on the pace and direction of the U.S./Soviet strategic competition.

The MIRV case illuminates several of the hypotheses about the interaction between arms limitation and procurement suggested above:

Technological Asymmetry: The significance for arms limitations of one side's fear of being "frozen out" of a strategically significant technology application is clear enough from the MIRV case. In effect, partly as a result of the delay in opening the SALT negotiations caused by the Soviet invasion of Czechoslovakia in August 1968, the first time window for a MIRV ban agreement, which would have occurred before either side's test program had progressed very far*, had in effect closed by the time serious negotiations got under way.

*"Only during the opening months was there a chance to stop MIRVs": Smith, op. cit. p. 472. It is obvious enough that the fact that the MIRV ban issue arose at the start of a new negotiating process made it much harder to contemplate on the U.S. side. Proposals were made within the Administration to "stretch" the window by slowing down the U.S. MIRV testing program, but they were not adopted.

Technological Momentum: MIRV was an example of a new program which had exhibited a particularly good track record. The requirement for assured penetration of anticipated ABM defenses had motivated a development program with major technological challenges in guidance systems, small propulsion systems, small warheads, reentry technology, etc. These challenges had been all but overcome by the time SALT negotiations started in earnest, so that the technological momentum was extremely high.

> Application Diversity: MIRV was a classic example, used by York, of a multipurpose technology application, which appeared to solve a number of potential problems, such as coping with ABM and SAM upgrade, to meet other desiderata, such as increasing U.S. target coverage, and to have quite different applications, such as the multiple launch of satellites. It is therefore not surprising that it accumulated the support of diverse constituencies with differing interests and requirements, whose combined strength made it hard in the extreme for the Administration as a whole to contemplate imposing stringent limitations on it.

The MIRV case also illustrates the proposition that accurate judgments regarding the impact of arms limitation proposals and the procurement of new military technologies on the U.S./Soviet strategic relationship require realistic net assessments as to the pace and future development of the new technologies and their strategic implications. The evidence strongly suggests that the decision process on MIRV limitations was not based on a good, coordinated net strategic and technical assessment of the implications, over the medium and longer term as well as in the short term, of unrestrained MIRV deployment on both sides. What did exist was a range of widely differing views as to the Soviet ability to develop and exploit MIRV technology quickly. The JCS tended to discount this prospect; OSD saw it as more realistic, but saw MIRVed ICBMs as a means of increasing warhead numbers; ACDA and the State Department were strong proponents of MIRV limitations. In the end, the impending

Minuteman III deployment and the unconstructive Soviet response to the initial proposal relegated the possibility of a MIRV ban to one of the briefest negotiating histories in the entire SALT experience.

2.2.3 ABM

It was always obvious that the widespread deployment of ABMs would be of major strategic importance. It posed a clear challenge to the U.S. orthodoxy of mutual deterrence (while being quite consistent with Soviet damage limiting concepts) and raised the whole range of questions associated with strategic nuclear "warfighting". However, the way in which unfettered ABM deployment would affect the U.S./Soviet strategic balance was not altogether clear. In terms of technology, the Soviets had, as it was perceived at the time of SALT I, a more primitive system, but had started to deploy it sooner. The United States, with a more advanced, but still questionably effective, system, had held back on deployment and was wrestling with considerable internal skepticism about the desirability of ABM deployment. Most people at the time believed that MIRVs and/or penetration aids could negate the effectiveness of even an advanced ABM system, and at a cost ratio adverse to the defense. Thus both sides had some kind of leverage over the other as they moved into the SALT negotiations, while neither seemed close to a capability to deploy a system so advanced as to confer even short term strategic advantage in an all-out ABM competition and the associated race to build up offensive capabilities to saturate and defeat ABM systems. Finally, the possible deployment of ABMs introduced the issue of third country impact on the superpower strategic relationship. From the Soviet point of view, there was concern with the strategic threat from the UK, France and China. The U.S., despite the anti-Chinese dressing given to the limited Sentinel program, was prepared to accept, at least for a limited period (note the Treaty's five year review clause), the possibility of a Chinese threat. At the same time, the United States had an interest, albeit modest, in protecting the British

and French capability to strike certain Soviet targets, including notably the Moscow area, with their strategic nuclear forces. In this situation, an arms limitation approach was both obvious and attractive, not least because an ABM/counter-ABM race would have been highly expensive.

The hypotheses suggested earlier are also illuminated by the history of ABM, though in a different way:

Technological Asymmetry: At the time of the SALT negotiations there was perceived to be a relative technological symmetry in U.S. and Soviet ABM development. Although U.S. technology was almost certainly seen by both sides as more advanced, both sides had been sobered by the immense technical challenge of a truly effective ABM system, be it for population or hard-site defense. In fact, it was becoming increasingly apparent that achievement of an effective ABM system would have required a major technological advance -- which neither side could be confident of being the first to achieve. To the extent that the United States may have had an advantage in the existing technology, this was offset by the strategic uncertainty of its efficacy and the consequent political uncertainty as to whether the support for ABM funding could be sustained. In this situation, the balanced fears of the costs -- financial and strategic -- of an ABM race facilitated negotiations.

Technological Momentum: As suggested above, the momentum of ABM development was not particularly great. In effect, the slope of the learning curve was relatively flat and the distance to be travelled before either side crossed the threshold of technological development needed for a strategically significant and financially affordable deployment was relatively great.

Application Diversity: The state-of-the-art ABM technology was essentially a single-purpose one (in the York parlance) and there fore had no broader constituency on which to draw. As a consequence, a net assessment which demonstrated the advantages of mutual limits on ABM systems was much easier to sell. In this context, it is noteworthy that some of the more recent technological possibilities for ABM (e.g. high-energy lasers) are not single-purpose but, like MIRV, multipurpose.

2.2.4 Cruise Missiles (CMs)

Perceptions of the strategic importance of advanced cruise missiles and cruise missile technology have changed radically over time. From the modern CM program's initiation in 1972, the weapon's very diversity and potential has drawn opposition and skepticism, as well as creating appeal within the defense establishment. Many saw advanced cruise missiles as undercutting traditional roles and missions of the Air Force and the Navy. The Air Force, not unreasonably, saw ALCMs as competitive with manned bombers and specifically the B-1 program. The Navy saw land-attack CMs as deflecting the Navy from its principal, naval missions, while having little interest in nuclear CMs in an anti-ship mode. However, the advanced CM development program in the United States was essentially maintained on the initiative of lower level OSD staff members, who thought advanced CM development was being ignored for unjustifiable reasons, and by broader government interest in amassing SALT II bargaining chips.

The relative lack of U.S. service interest in cruise missiles in the early phase of SALT II permitted them actually to be used as "bargaining chips" in the negotiations. The Soviets, for their part, appear to have been interested in slowing the U.S. technological lead. However, although an agreement limiting CMs in numbers and range for different basing modes was virtually concluded in January 1976, President Ford was persuaded that it would be politically unwise to consummate the emerging agreement.

By June 1977, appreciation of the significance of improvements in guidance systems, the demonstrated low altitude capability of the advanced CM and growing concern about the penetration capability of manned strategic aircraft brought ALCMs onto center stage as a strategic alternative to the B-1. With still only a marginal bureaucratic constituency, ALCM procurement was chosen by President Carter a. the alternative to deployment of the B-1. Following this decision, the CM bargaining chip became progressively more difficult to play in negotiations. Indeed, it became in effect a negative factor. The U.S. negotiators found themselves required to seek withdrawal of previously proposed restrictions (e.g. on range) and acute verification and counting problems emerged. In the same time period, interest in GLCM to resolve the perceived problem of an imbalance in long-range theater nuclear forces in Europe began to grow. Thus, in the SALT II agreements as signed by the two governments in 1979 long-range ALCMs were subjected to relatively permissive quantitative limits and long-range GLCM and SLCM deployments were banned for a period (until the end of 1981), during which neither side wished to deploy them anyway.

The cruise missile case illustrates the hypotheses advanced earlier in the following ways:

> Technological Asymmetry: As in the ABM case, the U.S. technological edge in advanced cruise missile technology appears to have given the United States some leverage over the Soviets, whose anxiety to arrest U.S. CM development seems to have been real. What is less clear, given the changes in U.S. motives and purposes concerning CMs in the SALT II negotiations, was how much the Soviets were ever prepared to pay for limitations on that development. Moreover, Soviet strategic requirements for cruise missiles would appear to be quite different from those of the United States (especially with respect to range) and this asymmetry has to be weighed in the

balance along with that in technological capability.* Finally, although the Soviets may have lagged in advanced cruise missile technology, there was never any risk that they would be wholly frozen out of the cruise missile business, in which they had already been active for many years. Thus the CM case tends to support the view that a U.S. lead in the application of an important strategic technology can provide a compelling incentive to the Soviets to engage seriously in arms limitation discussions and to contemplate corresponding concessions in other areas. It is also compatible with the view that freezing a technological monopoly is unlikely to be acceptable to either side. What remains debatable is the Soviet assessment of the strategic importance to them of advanced, long-range CMs and therefore the sacrifice that they would have seen themselves as making in accepting a ban on all, or many, types of long-range CMs.

Technological Momentum: The CM case is an excellent illustration of the build-up of technological momentum as a development program progresses successfully towards the critical threshold for deployment. As the distance between that threshold and the point reached at successive times during the 1970s shrank, so the momentum of the program in many aspects (propulsion efficiency, guidance accuracy, etc.) grew steadily. Only some bureaucratic factors, such as the Air Force's reluctance to see any serious competition to the B-1 emerge, held it back. Thus the slow start-up of advanced CM development and the slow build-up of the constituency for advanced CMs indicate that perhaps until as late as the mid-1970s there was an opportunity for fairly stringent negotiated agreements on the control of advanced CMs (though this does not say anything about the desirability of such agreements).

---

*For a discussion of this subject see Group-Captain R. Palin: "Cruise Missiles and Arms Control-Military Implications of the 600 km Range Limitation": Paper prepared for a colloquium sponsored by the International Studies Program of the Woodrow Wilson International Center for Scholars at the National Defense University, Fort Lesley J. McNair, Washington, D.C., on 8 July, 1980.

This was affirmed by the compromises negotiated by Dr. Kissinger in Moscow in January 1976, which were overtaken by events. Thereafter, the technical success of the advanced CM program and the evidence of Soviet plans for air defense modernization led in mid-1977 to the choice of CMs rather than the B-1 for the next stage of modernization of the air-breathing component of the strategic triad and radically transformed the prospect for arms limitations affecting CMs.

Application Diversity: The inherent flexibility of the advanced CM technology and its multiple applications (RPVs, anti-ship, TNF, strategic) have, even more than the MIRV case, created a complex set of constituencies and interests which, even if some restrictive (as opposed to permissive) arms limitation proposals could be shown to be attractive, would make adoption of them extremely difficult. The flexible nature of CM technology also creates technical difficulties for designing arms limitations, notably over verification. CM range and payload (nuclear warhead, conventional warhead or sensor) are hard to distinguish and will provide serious challenges to verification in any future arms limitation agreements affecting CMs.

Finally, the cruise missile case again underlines the importance of a good net assessment of the implications of both arms limitation options and of unrestrained long-range deployment on both sides. It is not clear that such an assessment was in existence within the U.S. government during much of the period during which CMs were being discussed in SALT. Indeed, and this is a point which bounds the time window for arms limitation, such a net assessment would have been difficult to make in the early stages of SALT II, in view of the newness and flexibility of the technologies associated with advanced CMs.

2.2.5 European Theater Arms Limitation

The interaction between arms limitation and defense procurement in the European theater has been shaped by several factors specific to that theater and to arms limitation negotiations there.

First, European theater arms limitation efforts -- unlike those in SALT -- have not sought to constrain the application of new technology to the theater. Rather, the Western side has consistently viewed technology as an equalizer which can compensate for Warsaw Pact advantages in manpower and quantities of armaments. Deployment of new equipment of all kinds has continued at high levels on both sides since MBFR negotiations began in October 1973. Indeed increased European acceptance of the importance of conventional force modernization has been among the positive results of the process of negotiation.

Second, the multilateral character of European theater arms negotiation has produced fundamental asymmetries between the bargaining positions of the United States and the Soviet Union. While the latter has apparently been able to call the shots in the Warsaw Pact's negotiating strategy and tactics, the NATO allies have operated in a truly collegial fashion, even though the United States has taken much of the responsibility for analysis of, and the initiative in proposing, allied positions.

Third, allied negotiating objectives have varied during the course of the MBFR talks. To be sure, the reduction of the Warsaw Pact numerical advantage in manpower has been a constant priority Western objective. However, the early Western preoccupation with reducing advantages in Soviet armor has been partially offset by developments in NATO ATW technology, while concern about the overall increase in Warsaw Pact conventional force capabilities, including Soviet modernization of theater aircraft and nuclear systems, has grown. The Soviets, by contrast, have consistently aimed at ratifying the advantages they enjoy in the European theater under the pretext that a "balance" existed in

the theater when the negotiations opened and would only be disturbed to Soviet disadvantage by disproportionate Warsaw Pact reductions such as NATO has sought.

Fourth, the complex mix of nuclear and conventional capabilities in the European theater confrontation, and the importance of manpower in determining the military strength of each side, has obscured the impact of technological change on the theater balance far more than in the case of SALT. Measuring the effect of improvements in individual elements of forces -- e.g. high performance aircraft, armor, or anti-armor systems -- on the outcome of combined arms operations in the European theater, and therefore on the "balance" in the theater, requires an even more complex and less certain calculus than that needed to measure shifts in the strategic force relationship. This factor makes the imposition of limitations on the applications of new general purpose force technologies less readily susceptible to analysis than is the case in strategic, or perhaps even long-range theater, nuclear forces.

Fifth, technological improvements affecting the European theater have, by and large, not resulted in breakthroughs in capability, but have been incremental in kind. Such incrementalism has damped down the perception on both sides of a technology race in the theater. Moreover, deployment decisions on both sides have been primarily affected by alliance and doctrinal considerations specific to the European theater. Hence, the essentially defensive strategic objective of NATO has dictated forces with different characteristics than those of the Warsaw Pact (the tank-anti-tank relationship is the classic example of this). Likewise, the continuing political need to "couple" the U.S. strategic arsenal to the theater and NATO's essentially political nuclear strategy has created requirements for theater nuclear forces in which "balancing" or matching Soviet TNF deployments has been only a minor factor.

The most striking attempt to use proposed limits on weapons systems as leverage in MBFR was NATO's Option 3 proposal. This called for the trade-off of obsolescent theater nuclear systems for limitations in Warsaw Pact tanks. Specifically, NATO offerred to withdraw 1,000 nuclear warheads, 54 F-4 aircraft, and 36 Pershing missile launchers in exchange for a common manpower ceiling of 900,000 and withdrawal of 5 Soviet divisions from East Germany. Option 3 was tabled in December 1975. Its logic was steadily eroded by the modernization of Soviet theater nuclear forces, which threatened to leave NATO with self-imposed limits on such forces while the growth of Soviet capabilities was unconstrained. For this reason, and because of Soviet attempts to bargain on a proposal which was intended as a once-for-all offer, Option 3 was withdrawn in December 1979. However, during the years that Option 3 remained on the table, it did have a direct impact on NATO procurement and deployment. The need to preserve Option 3 extended the F-4 deployments in Europe and helped insure that follow-on F-16 aircraft were wired to be nuclear-capable.

More recently, the relationship between force modernization and arms limitation on the NATO side has evolved in quite a different direction. For reasons primarily rooted in Western European internal politics and psychology, NATO nuclear force modernization, on both the short and longer ranges of the TNF spectrum, has been held hostage to Western European insistence on parallel Western arms limitation initiatives covering the systems to be modernized. This demand for parallelism between force modernization and arms limitation has added further ambiguity to their relationship in the Alliance context and suggests that, for some at least, arms limitation proposals have become a necessary prior condition for modernization or even an instrument for preventing it. While this situation will not necessarily be of indefinite duration, for the time being it will continue to complicate the successful integration of arms limitation and defense procurement planning in any area in which the allies are necessarily engaged collectively.

Hypotheses about the relationship which are illuminated by the European theater are:

Technological Asymmetry: The experience of negotiations on the European theater general purpose force balance has been so little concerned with weapons systems that the impact of the technological asymmetry on those negotiations is hard to assess. However, as suggested above, asymmetries in force posture, operational concepts, and doctrine between NATO and the Warsaw Pact are so deep and so fundamental that they have made judgments about "fair" bargains for the limitation of general purpose force equipment virtually impossible. As one, not very significant, example of this point, when the United States advanced the idea of seeking a quid pro quo for a self-imposed limitation on deployment of the ERW, it could not define precisely the corresponding Soviet limitation that it sought.

Application Diversity: Demand for the application of technologies to the improvement of allied capabilities in the European theater is driven by so many broad and multifaceted factors, covering the requirement for general purpose forces worldwide as well as the balance in Europe, that it is bound to make harder the formulation of plausible arms limitation possibilities. The experience of MBFR vividly shows how great is the susceptibility of arms limitation proposals to be overtaken by force modernization.

2.2.6 Chemical Warfare Arms Limitation

The case of chemical weapons arms limitation was judged worth including for several reasons. In the first place, it is one of the longest-lived arms limitation issues, dating back to the negotiation of the Geneva Protocol of 1925, which prohibited the use of chemical weapons (though in practice many of the parties to it, including the Soviet Union and the United States, the latter of which only ratified it in 1975, reserved a right to retaliatory use and the Protocol is therefore

tantamount to a ban on first use). Secondly, the issue of chemical weapons is surrounded by a high level of political sensitivity in both the United States and Western Europe, which has had a substantial influence on the course of Western policy in recent years. CW arms limitation is therefore a distinctive case.

In the United States, interest in CW arms limitation revived after the successful conclusion of the Biological Weapons Convention in 1972. But, while there were some similarities between the two cases, notably in terms of rising public intolerance in the United States of the use, and even the storage, movement and production, of either type of agent -- something which had not existed at the height of U.S. CW production in the 1950s -- there were two major differences. First, despite its limited knowledge of Soviet CW capabilities, the United States was sure it could not afford for CW the gesture of unilateral disarmament which had opened the road to the BW Convention; and, second, military skepticism about the value of CW was much lower than that about BW. The absence of strong intelligence on Soviet CW production, stockpile and employment practices made any conclusive strategic evaluation of CW arms limitations extremely speculative, with some contending that the evidence supported the view that Soviet preparations were essentially defensive and others emphasizing their offensive capability and doctrine. Thus, while there were considerable political incentives for the U.S. government to keep alive the idea of CW arms limitation, as indeed it did by agreeing to the U.S./Soviet joint statement at the July 1974 summit, the problem, and especially its verification aspects, could not be treated as flexibly as those of the BW Convention had been.

In Western Europe, the allies had traditionally taken a "don't want to know about it" attitude towards the Alliance's CW capabilities, whose function and operational concepts were shrouded in even greater ambiguity than those of allied theater nuclear forces in Alliance strategy documents. Thus, not only did the Alliance find itself with a seriously maldeployed and operationally limited stockpile forward-based in Europe, but any raising of the issue was likely to arouse

a political reaction, especially in the F.R.G., which could lead to a request for its removal. Few countries in Europe were immune from this view of CW, which was, if anything, even less well "assimilated" by European elites and public opinion than nuclear weapons.*

As a consequence of this situation, the Alliance found itself in a dilemma. There was little sign of a consensus emerging around a more convincing CW posture in Europe -- indeed even the production of binary weapons to replace the existing stockpile was effectively stymied in the Congress throughout the 1970s and into the 1980s. But the problems of definition and verification which beset any serious CW arms limitation negotiations were impenetrable. The definition of the CW agents to be limited could not be satisfactorily resolved, while the adoption of a general "purpose" clause promised to be virtually impossible of verification. As to verification, there was little prospect of improving non-intrusive monitoring techniques, while even intrusive techniques were of questionable value given the interchangeability of many civilian and military chemical production facilities and the reluctance of the U.S. chemical industry to submit to intrusive monitoring.

The CW case does not lend itself readily to interpretation in the light of hypotheses about the relationship between technological development and arms limitation possibilities suggested for the previous four cases. The three principal characteristics of the CW case are, however, worth mentioning. First, the relatively balanced capabilities of the two sides in terms of technology and its application to weapons, even though the United States may have more advanced concepts for binary munitions. However, the advanced munitions would not involve any significant strategic impact as compared with those already in the

*For a useful discussion of this and other aspects of the CW problem, see Julian Perry Robinson: "Chemical Weapons for NATO: A Framework for Considering Policy Options" in Chemical Weapons and Chemical Arms Control: Carnegie Endowment for International Peace: New York and Washington, D.C.: 1978.

stockpile and, thus, technological developments in themselves are unlikely to create the kind of incentive for arms limitation which was seen in the MIRV or ABM cases. Second, the constellation of political forces which has prevented any Western CW modernization througnout the 1970s and which is likely to continue, perhaps with somewhat diminished force in the United States, into the 1980s. In this sense, the United States and the allies have been subject to an incentive to investigate arms limitation possibilities comparable to that which applied to the ABM issue in SALT I. Third, the technical difficulties standing in the way of any verifiable arms limitation agreement. The case is thus an object lesson in the obstacles which can plague arms limitation approaches even when, as with two superpowers and their allies who have renounced the first use of CW, many of them for over 50 years, there would on the surface appear to be a considerable consensus in favor of finding such an approach and no reason associated with the comparative levels of technology development to prevent agreement.

2.3 MORALS FOR THE FUTURE

The history of major arms limitation initiatives since World War II, of which these five cases represent the most important episodes for present purposes, is rich and varied enough to preclude any single set of conclusions and interpretations. Nevertheless, the summary presentation of these five cases does justify some initial comments by way of background to the subsequent analysis of future arms limitation opportunities.

In the first place, the interactions between national strategy, international relationships and arms limitation are of critical significance. Arms limitation, properly understood, is a means to achieve broader national objectives, not an end in itself. Where those objectives are indeterminate, inconsistent or subject to frequent or rapid change, the use of arms limitation -- or any other means of policy -- is likely at times to prove unsuccessful and even self-defeating.

The frequent criticism of U.S. strategic arms limitation policies in the 1970s -- that they were premised on a mistaken belief that U.S. and Soviet strategic doctrines and concepts either would or could be made to converge -- was in part well founded. But the incorrectness of that belief is not in itself a decisive argument against arms limitation agreements that were negotiated during that period. Agreements that two nations both correctly gauge to be in their interest in the light of their different strategic concepts are not logically impossible, though they may be relatively difficult of attainment.

Much more problematical is the attempt to achieve arms limitations in a situation in which one country's strategic concepts are either unclear or disputed within that country. That this was a weakness of U.S. arms limitation policy in the 1970s is also apparent. That it could again be a weakness in the future is equally obvious. For the purposes of analysis, the important thing is to be quite precise as to the assumptions concerning both U.S. and Soviet strategic concepts, objectives and policies on which any particular arms limitation proposal is based. The question for analysis then becomes whether either side, or both, in the light of their assumed, different strategic objectives and policies would be likely to see advantage in the proposal. It is a matter of policy decision as to whether to accept the assumptions on which the analysis rests.

The ABM Treaty case is perhaps the most instructive in this connection. The fact that, as has frequently been pointed out, the Soviets have apparently not accepted mutual assured destruction as the, or perhaps even a, major objective of their strategic policy did not obstruct their decision in 1972 that it was in their interests to accept the Treaty in the light of whatever strategic objectives they had at that time set for themselves. The conclusion of most analyses since 1972 has been that the major reason for this was the U.S. lead in the

then current ABM technologies.* At the same time, a strong case can be made, that in the political, economic and strategic situation in the United States at that time, avoidance of an ABM-counter-ABM competition was of positive benefit to the United States. What such a conclusion does not imply is that the balance of advantage and disadvantage perceived by the two sides in 1972 will remain the same indefinitely. Nor does it imply that that balance will necessarily change to the point at which one side or the other judges the Treaty as being against its best interests.

The issue, therefore, is whether, in the light of the strategic concepts and the balance of technology prevailing and projected for the 1980s and beyond, the two sides should -- or will -- draw different conclusions than they did in 1972. Thus the progress made in the United States in ABM technology in the interim, which advocates of ballistic missile defense are rightly canvassing**, can potentially serve at least two different purposes -- to provide a degree of ABM defense or to attempt to convince the Soviet Union once again that a *more or less unrestrained* ABM-counter-ABM competition would be likely, on balance, to diminish Soviet ability to achieve Soviet strategic objectives even though strategic defense may be prominent among those objectives. Which of the two purposes the United States should prefer to adopt as its primary goal and manipulate its technological assets to achieve thus becomes an issue of analysis of how best to attain U.S. strategic objectives on the basis of various assumptions about Soviet

*The Soviet view of the ABM Treaty will be discussed further in Chapter 3 below.

**See, for example, "Ballistic Missile Defense: A Potential Arms Control Initiative" by G.D. Barasch et al, Los Alamos National Laboratory, Paper LA8632, January 1981, and "SALT: Deep Force Level Reductions" by Colin S. Gray and Keith B. Payne, The Hudson Institute, Inc., March 1981, report prepared for the SALT/Arms Control Support Group, Office of the Assistant to the Secretary of Defense (Atomic Energy) under Contract No. DNA001-79-C-0392. See also Gray's article "A New Debate on Ballistic Missile Defense" in Survival, March/April 1981.

behavior. There is certainly no a priori reason to believe that the Soviet interest in strategic defense automatically rules out any prospect of extending the ABM Treaty essentially as it stands.

A second point concerns the disparity between the inherently dynamic nature of the East-West military and technological competition and the relatively static nature of arms limitation agreements. While such agreements can be changed, this can by and large only be done with some difficulty, though mechanisms, such as the Standing Consultative Committee (SCC) set up under SALT I, can be devised to facilitate flexibility. Similarly, if such agreements are not of some significant duration, they are likely to have little certain practical impact. The ABM Treaty, being of indefinite duration, is a good example of the relatively static nature of arms limitation agreements. While changes have been made to the Treaty through the SCC mechanism, they have reinforced rather than modified the basic thrust of the Treaty, i.e. to impose an effective prohibition* on ABM deployments. By contrast, the proposed SALT II Treaty, some of the most important constraints in which (e.g. on fractionation of warheads) would have expired before their principal strategic impact and purpose was achieved, is a good example on the other side of a short duration Treaty with correspondingly little sure impact. Proposals for a 3 year, fixed duration Comprehensive Test Ban fall into the same category.

In considering, as this study does, arms limitation which has some significant impact on the defense procurement planning process, the types of limitation of principal interest are those of relatively long duration which tend to mold the course of the strategic competition and are not subject to frequent change to take account of the evolution of the technological preferences and capabilities of the two sides. For

*By effective prohibition is intended an agreement which imposes constraints on a particular technological application so severe that the principal strategic purpose of that application is in effect frustrated. The limits on ABM systems and their components in the ABM Treaty are examples of an effective prohibition.

this purpose, the problem of forging agreements which of their very nature are comparatively static, but which can withstand the dynamic pressures of technological development is a real one. For, as the ABM case has shown, agreements whose original negotiation owed much to a particular set of circumstances (in this case a U.S. technological lead the Soviets wished to blunt) can start to atrophy if care is not taken to ensure that those circumstances are either preserved or replaced by others equally compelling. Otherwise, the net result of the agreements will merely be to postpone events (though that is not necessarily against the interests of the parties to them).

A third issue, already discussed in connection with several of the cases summarized earlier, concerns the time periods -- or "windows" -- within which attempts to achieve arms limitations in the form of the prohibition or effective prohibition of new technology applications which may be assessed as being in the U.S. national security interest have the greatest chance of being successfully negotiated. The hypotheses derived from the case studies suggested that three separate factors might be involved in defining these time windows.

First, the relative states of development by the United States and the Soviet Union of a particular military application of one or more new technologies. The hypothesis was most strongly illustrated in the MIRV case, where the apparent prospect that the Soviets might be frozen out of the capability to apply the technology altogether by a test and deployment ban was apparently a major reason why such a ban was not achieved. But a similar case could be made concerning the Baruch plan for the internationalization of nuclear energy, possibly for the Biological Weapons Convention (which was negotiated only after a unilateral U.S. commitment to abolish its BW stockpile), or for the limitation of ASAT capabilities (where the Soviet lead in development has been one among a number of factors inhibiting U.S. interest in arms limitation possibilities).

The second factor concerns the amount of technological and bureaucratic momentum behind a particular development -- with restrictions on the application of highly successful technology development programs coming close to the threshold of deployment being difficult to achieve. This factor was illustrated by the MIRV, ABM and cruise missile cases. With MIRV, a successful development program, which was about to achieve deployment, had acquired a solid political and military constituency which was ill-disposed to serious examination of limitations. With ABM, the development program had wallowed for nearly a decade, unable to solve the problem of high confidence intercept of ballistic missile RVs or to overcome doubts about the results and costs of an ABM-counter-ABM competition. With cruise missiles, lack of interest led to lack of development funding and little momentum --thus creating for a time an environment in which highly restrictive CM limits were almost agreed. But increased interest in the program, albeit in part for bargaining rather than military reasons, led to rapid technological progress and a subsequent backing away from any significant CM limits.

The third factor concerns the diversity of military applications of a particular technology. Here, the contrast was drawn between the MIRV and cruise missile cases of hydra-headed technologies, the thrust towards which came from more than one direction and satisfied interests and requirements of multiple customers, and the ABM case of a single purpose technology, the thrust of which could be slowed, if not wholly arrested, by addressing a single potential strategic issue.

Generalizing from the graphic displays used in Figures 2.1 and 2.2, Figure 2.3 shows a graphic representation of technological momentum (M). The figure shows that at any time in the development of a given technology, M is directly related to the rate of progress towards operational effectiveness of its military application ($\frac{dE}{dt}$) and the inverse of the distance remaining between the technological advance achieved at any given time (E) and the level required for operational

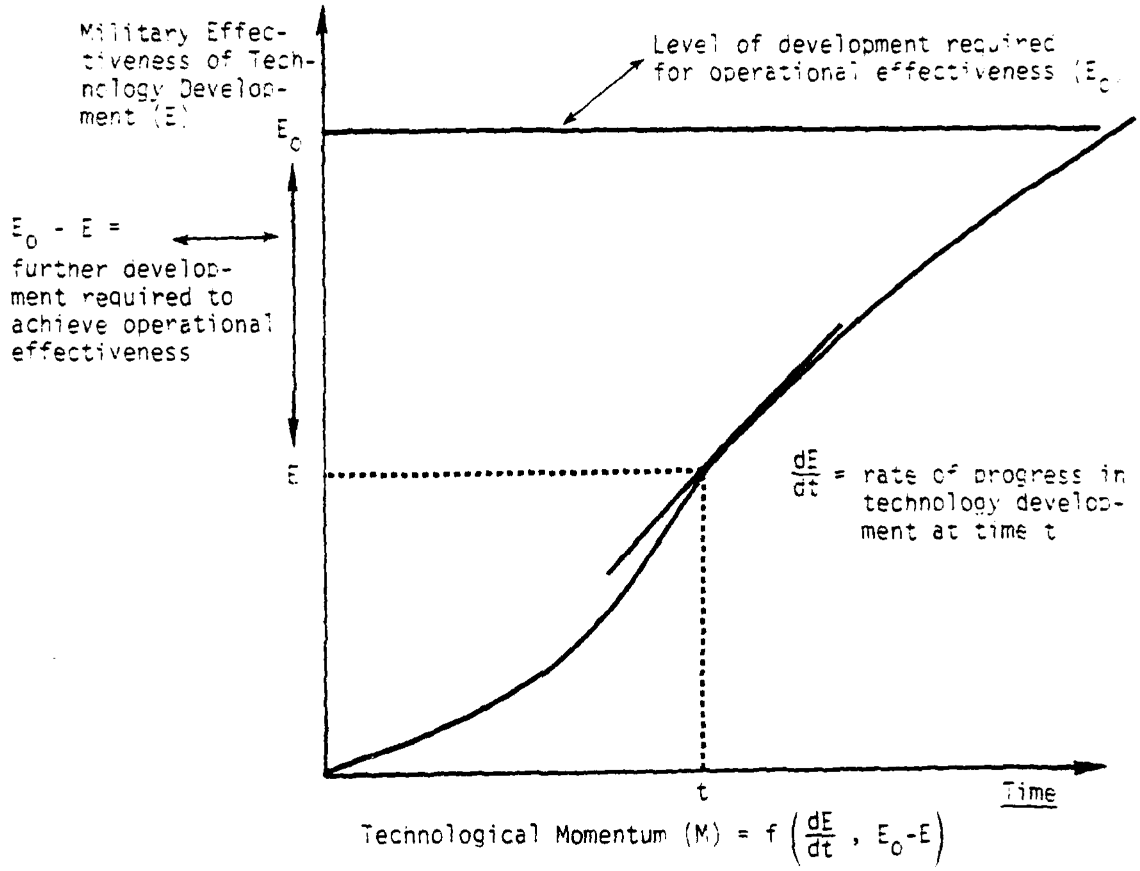

Figure 2.3: General Representation of Technological Momentum

effectiveness (E_0). Both the cases discussed earlier and general experience suggest that bureaucratic momentum is highly correlated with technological momentum.

The implication of these three hypotheses taken together is that there may be arms limitation time windows defined by the relative states of development of specific technologies and systems concepts on the two sides, the technological and bureaucratic momentum towards their development on one or both sides, and the diversity of their applications for one or both sides. Typically, as suggested by Figure 2.4, there would be two such windows in the lifetime of a particular technology or systems concept during which prohibitions or effective limitations* could be achieved.

The first would open after development had proceeded successfully to the point at which the characteristics of the system were clearly enough defined to permit its strategic significance to be gauged and a detailed assessment of arms limitation possibilities to be made, but before either side's development program had reached the point at which one side, but not the other, was ready to produce and deploy the system. During this period, prohibition (or effective prohibition) of even development and testing of the system on both sides would be a realistic option. This window might in some cases be open for a long time, e.g. when a development program makes little headway or stalls, due either to inability to solve a technical challenge (e.g. ABM in the late 1960s/early 1970s) or lack of military interest/financial support (cruise missiles in the early 70s). But in other cases, this window may only open extremely briefly, as was the case with MIRV, which moved quickly through a successful development program to a point at which the system was ready to be deployed.

---

*"Effective limitation" is used to describe a limitation which involves a real reduction in the planned program of one or the other side. The distinction between an effective limitation and a limitation which merely ratifies the planned program of both sides is, at least in theory, a significant one.

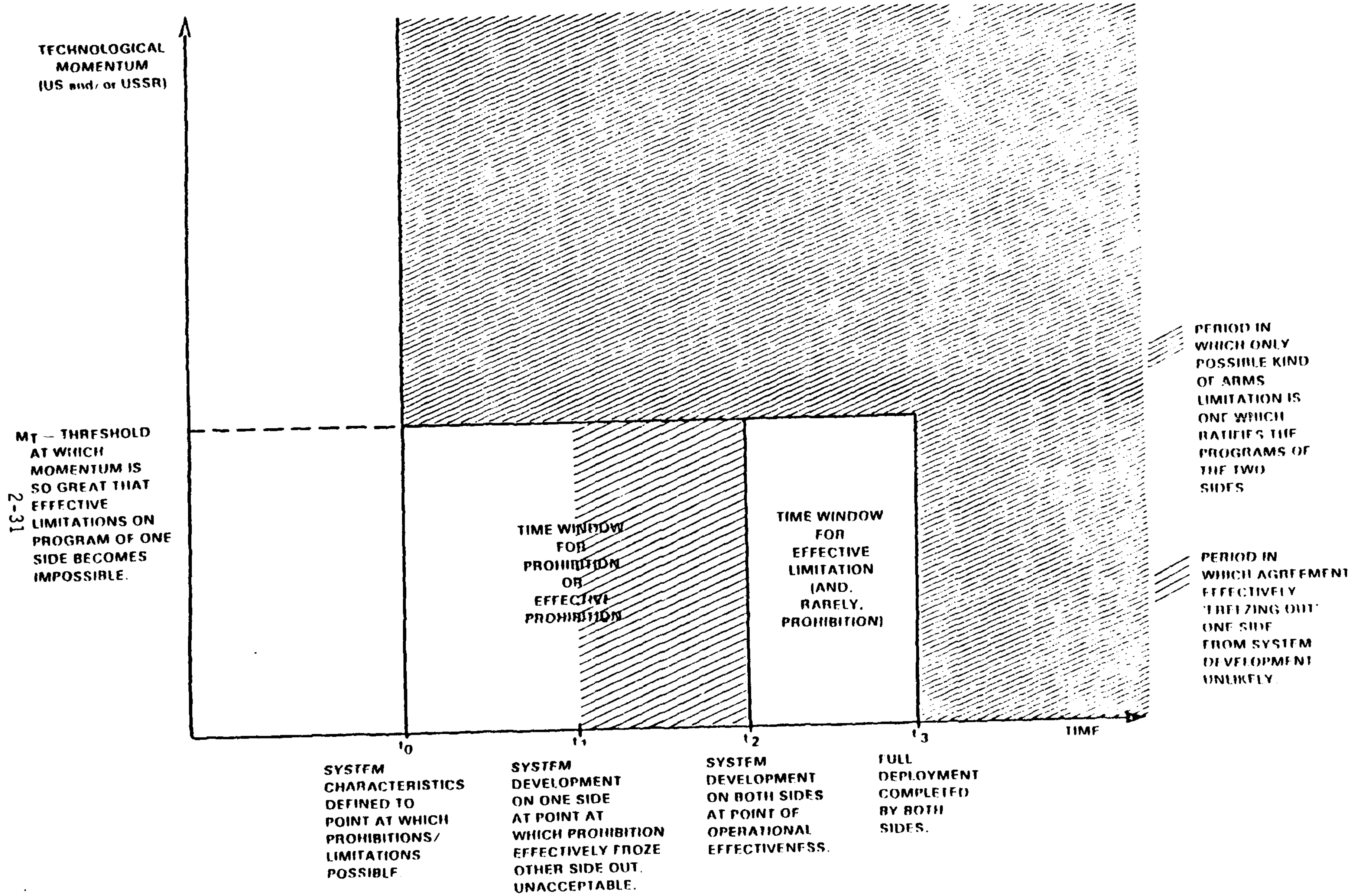

FIGURE 2.4. GENERAL REPRESENTATION OF TIME WINDOWS FOR ARMS LIMITATIONS INVOLVING PROHIBITIONS, EFFECTIVE PROHIBITIONS AND EFFECTIVE LIMITATIONS.

During the period in which only one side had mastered the technology and its military applications and would have to be assumed to be capable of deploying operationally effective systems, there would be a significant inhibition on the part of the other about entering into an arms limitation agreement which prevented it from perfecting, as well as deploying, the technology application. This was the case with the U.S. MIRV test ban proposal. The second window opens after both sides have mastered the technology, but before full-scale deployment has been completed. Since at this point the military demand for the system would generally be real, the most likely arms limitation options would be for fairly permissive numerical limitations on deployments, though stricter limits, effective prohibitions or even complete prohibitions would still theoretically be possible.

This last comment suggests that, just as the windows are bounded vertically by different stages of the development cycle of a given technology application, so they are bounded horizontally by the level of technological and bureaucratic momentum which has developed around that application. It is useful to think in terms of the level of momentum, as defined earlier, at which any effective limitation in the program of one side becomes improbable, if not impossible. This concept is important not least because it incorporates the influence of the strategic objectives of the two sides, which inevitably bears heavily on particular technology applications as they near operational effectiveness. Thus, as was seen in the MIRV case, the strategic importance of a successful development program may be so great as to cut off any chance of effective prohibitions or effective limitations well before the two windows have closed. By contrast, as in the numerous prohibitions on technology applications of little strategic attraction to either side contained in the SALT I and proposed SALT II agreements (which are listed in Figure 3.2), the level of momentum can be so low as to leave the window for effective prohibition or effective limitation open for lengthy periods.

Appendix B contains a graphic representation of the arms limitation windows along the lines of Figure 2.4 for the MIRV, ABM and Cruise Missile cases discussed earlier.

There is another important dimension of the concept of arms limitation windows. Just as the development cycles of the two sides would appear to define times at which it may be most profitable to open arms limitation negotiations of different kinds, so they seem to define times beyond which it is most unprofitable to continue them. The idea of setting a terminal date beyond which one would be unwilling to pursue negotiations on a given subject is a relatively unfamiliar one in the recent history of arms limitation negotiations. But there may be both tactical and political reasons for considering it further. Tactical, in the sense that it could focus the minds of the negotiators and their governments and facilitate a relatively brief, if hectic, negotiation. Political, because it would remove much of the suspicion that arms limitations were being pursued for their own sake, in neglect of outside developments, or that negotiations were being used as the justification for delaying or deferring needed force posture improvements (the clearest case being the rather trivial one of the 1,000 U.S. warheads in Europe in MBFR. Other more serious, if also more debatable, cases could be adduced in the strategic force arena, in which the very existence of arms limitation efforts has frequently been argued to act as a sedative to the vigilance of democratic societies.).

The fourth comment prompted by the cases studied flows directly from the third. It concerns the importance of a thorough process of net strategic and technical assessment to the evaluation of arms limitation possibilities. This process would be quite different from the arms control impact statement (ACIS) approach adopted in recent years. Whereas the ACIS was designed to assess the impact of defense procurements on arms limitation possibilities, the net strategic and technical assessment approach would be more akin to a

national security impact statement, which would evaluate the impact of both arms limitation possibilities and unrestricted deployments of various systems on the overall U.S. security position. The process would therefore be one which would be both conceptually and bureaucratically more balanced than the existing process and would, in addition, represent a vehicle for gauging both arms limitation proposals and defense procurements in relation to the statement of national strategy and objectives contained in the Defense Guidance document.

The concept of a national security impact statement or net strategic and technical assessment approach to arms limitation policy planning is easier to state than to implement. Like any future oriented procedure, it would involve a considerable amount of speculation and therefore be difficult to conduct rigorously. Since, as has been hypothesized above, relative timescales of development may be critical to an understanding of what arms limitations may be attainable, when they might be negotiable, and what their relative advantages and disadvantages would be for the two sides in the short, medium and longer terms, technology forecasting concerning the relevant technologies and evaluation of likely strategic relationships under different assumptions would play an important part in the process. In order to ensure that the forecasts used in any particular net assessment were as good as possible, various techniques, including gaming and Delphi questionnaires, as well as intelligence estimating, could be used. As to the strategic evaluation, this would have to include, as discussed above, the best available Soviet-style strategic analysis of the particular issue or system involved*, possibly using alternative assumptions about Soviet strategic objectives and policies, and of its significance in relation to U.S. strategic objectives. On this basis, the merits

*This subject will be discussed in more detail in Chapter 3 below.

and demerits from the U.S. point of view of alternative future regimes, including in each case various arms limitation regimes and a "no-arms-limitation" regime could be assessed.

It is clear that significant uncertainties would remain after this process had been applied to any particular case. Technology forecasting is, at best, imprecise, though it is possible to minimize the imprecision by such techniques as cross-impact analysis. Our understanding of the Soviet view of the arms limitation/technology development/procurement nexus is likely to remain partial. Nevertheless, a systematic attempt to analyze alternative regimes affecting critical technology applications, some involving different arms limitation possibilities and others involving unrestrained development and deployment, and to explore the critical trade-offs between the long, medium, and short-term advantages and disadvantages of various regimes to the United States could be of great value. In the final analysis, the net assessment would only provide part of the basis for policy judgments and decisions --albeit a critically important part. The absence of such an assessment in the past has, as the MIRV and CM cases in particular suggested, tended to increase the scope for "surprises" after the event, in the form of changes in the strategic relationship derived from the development of technology which were either not considered or insufficiently thoroughly assessed in advance of a decision on arms limitation prospects.

Two final points to be made at this stage concern defense resource planning and Alliance relationships. Thus far in this study, the concept of net assessment has been divorced from any concept of cost (whether budgetary or in terms of force structure). The reason for this lies in a preference for achieving a sound initial understanding of the strategic implications of possible developments uninfluenced by considerations of cost. Nevertheless, the cost factor must be obviously introduced before policy decisions are made. In doing this, it is important to think in terms of opportunity costs as well as budgetary

costs, since in many cases the effect of saving in one area as a result of arms limitation (e.g. on ABM) will be to channel resources to other areas of defense spending, rather than to achieve a net saving. This issue is a nebulous one which has not been examined in detail in this study. It is mentioned here for the sake of completeness and to underline its importance.

Similarly, the problems of Alliance relationships and political factors in the United States and abroad represents an important dimension of many arms limitation possibilities. The Alliance dimension has appeared directly in all the cases studied except that on MIRV (although in any study of the indirect influence of the MIRV case, the harmful consequences of unrestricted MIRV deployments on allied perceptions of the adequacy of U.S. strategic forces to underpin U.S. international policy would be a crucial element). In the ABM, cruise missile, European theater arms limitation and CW cases, the attitudes of Western Europeans played a more or less central role in defining U.S. options both for arms limitation and defense posture planning. The broader matter of long-range TNF modernization, not reviewed in this section, has become a classic case of the interaction between arms limitation and defense procurement policies. Closer to home, the impact of domestic political factors was clear in all the cases except that of CMs (and can also be seen in other cases not reviewed here, such as that of mobile ICBMs). It is apparent that these factors, though hard to quantify, also need to be accounted for in any net assessment of the national security impact of the application of new technologies and, most especially, technologies which have a direct relationship to the military balance and force posture in the European theater. Other wise there is a danger that the United States might forego arms limitation opportunities which would impose constraints on both sides in favor of a situation in which, in the absence of negotiated constraints, the United States is unilaterally constrained as a result of Alliance -- and perhaps domestic political -- problems of an intractable nature.

3.0 UNDERSTANDING THE SOVIET ARMS LIMITATION/DEFENSE PROCUREMENT PLANNING SYNTHESIS

3.1 INTRODUCTION

The attempt to understand the complex interplay of factors that characterize the interaction of arms limitation, technological development and procurement processes in the Soviet Union is even more difficult than is the case in the United States. In the Soviet Union, an alien political culture combines with extraordinary secrecy to yield only fragmentary glimpses into the workings of any national security-related processes. The analysis in this chapter therefore draws upon three distinct modes of enquiry to provide perspectives on Soviet arms limitation and defense procurement planning. This chapter sequentially (1) examines the policy context and doctrinal imperatives which currently shape Soviet force structure objectives and, in turn, constrain the potential for limitations on emerging weapons-related technology; (2) attempts to illuminate essential attributes of the decision-making process in the Soviet Union which reconciles questions of limitation with exploitation of weapons technology; (3) provides several case study examples which illustrate Soviet arms limitation behavior and some general hypotheses about the conditions under which the Soviets will agree to or reject limitations on technology. Lastly, with insights gleaned from the prior contextual analysis, a number of emerging weapons technology areas are reviewed as candidates for application of the hypotheses in order to discover potential Soviet incentives for their limitation or their exploitation. It is, however, necessary at the outset to qualify the analysis which follows with the caveat that insufficient evidence exists, even in classified sources, to make a definitive statement regarding the relationships under scrutiny here.

3.2 DOCTRINAL CONTEXT OF SOVIET STRATEGIC DECISION-MAKING

American conceptions of Soviet interests in, and incentives for, entering into arms limitation negotiations have traversed the gamut of perspectives since the late 1960s. Early in that period many U.S. policy makers believed that embodied in SALT I was an implicit Soviet acceptance of the basic U.S. assumptions of mutual deterrence and of the necessity of maintaining nuclear stability codified in terms of parity in strategic forces. The parity of forces represented in the SALT agreements was therefore seen by many in the United States as providing a basis for an overall deceleration of the U.S.-Soviet strategic arms competition. However, the uninterrupted strengthening, both quantitatively and qualitatively, of Soviet forces during the decade has forced a re-evaluation of past assumptions about Soviet behavior. The current conventional wisdom is that a very different dynamic is operating within the Soviet Union. The result of this change has been to undo much of the carefully constructed logic with which U.S. policy-makers once approached the negotiating table. A careful reexamination of the policy context and doctrinal imperatives which shape Soviet force structure objectives and provide the framework in which Soviet arms limitation policy is formulated can contribute to a more accurate definition of the incentives the Soviets will have for both exploitation and limitation of various weapons-related technologies in the future.

Although a detailed treatment of the correspondence between doctrine and strategy on the one hand and developing Soviet capabilities on the other is beyond the scope of this study, such an analysis would almost certainly demonstrate that Soviet force deployments and characteristics are closely aligned with corresponding strategy. Where discrepancies in the fit occur, the reason appears to be that the implied force capabilities often require time to emerge according to the progress and priorities of development programs rather than that the underlying doctrine and strategy is not accepted as valid. In many

cases, Soviet strategic objectives continue to exceed existing capabilities. However, they remain goals toward which the Soviets appear to strive. One of the strengths of their system is the long-term nature of their planning process and the associated continuity of leadership, which facilitates steady progress toward these goals over an extended period of time. This being so, any analysis of possible future arms control opportunities must relate developing Soviet technical capabilities to these long term objectives.

The principal Soviet concepts about nuclear war, as written for internal consumption, show a logic quite different both from that which the Soviets would like the West to believe applies in the Soviet Union and from the concepts that underlie U.S. strategic policy. The introduction of nuclear weapons has not appeared to change the objectives of warfare as they have been prosecuted traditionally -- in distinct contrast to Western perceptions. General Bochkarev, who is believed to be a member of the General Staff Academy and is often published in authoritative Soviet military journals, has argued that if the Soviet Union was to accept that nuclear weapons have deprived the nation of the possibility of decisive political victory in warfare, then

> "the goal of defeating imperialism...and the mission of attaining victory...will have lost meaning and significance...and the very call to raise the combat readiness of our armed forces and improve their capability to defeat any aggressor is senseless." (1)

A major war, in the Soviet view, would be a coalition war -- a clash between two different social systems, Soviet communism and Western capitalism. Such a war would be a total war that would be pursued with decisive arms and would either begin as, or rapidly develop into, a nuclear conflict. Nevertheless, the war is not conceived by Soviet strategists merely as an exchange of nuclear strikes. Objectives and missions are carefully established and the operations of all military forces, not just nuclear forces, are coordinated and sequenced to achieve these objectives.

Although such a war would involve enormous destruction, the Soviets believe that steps must be taken both to prevail over their adversaries militarily and to survive as a coherent national entity. These imperatives explain the traditional approach taken by Soviet strategists to nuclear war -- i.e. devising a strategy designed to defeat the enemy and preserve the human and natural resources of the Soviet Union, and seeking to attain sufficient forces to make victory possible even under conditions of gross uncertainty. This Soviet perspective on nuclear warfare also demonstrates why Western concepts of deterrence and parity in forces are not regarded as sufficient bases on which to predicate the Soviet force posture (though they may be necessary elements of an overall strategic policy). Similarly, to rely exclusively, in the event of a failure of deterrence on a posture of the mutual vulnerability of U.S. and Soviet societies would be at radical variance with all the traditions and professional instincts of the Soviet military. It would accord equally poorly with the instincts of the political leadership, since the Soviets argue that a strategic balance based on mutual assured destruction merely aids the United States in preserving the international status quo, slows the "irresistible" social-political changes which must take place, and is inherently unstable. (2)

Preparing to fight and achieve victory in war is, therefore, the most important task of Soviet military strategy. The long term goals of this preparation include achieving both qualitative and quantitative superiority in military capabilities; developing and implementing war survival measures to ensure rapid recovery of the economic and military potential of the Soviet Union; and establishing measures for postwar occupation or control of the critical theaters of military operations, especially those with resources which could contribute to Soviet reconstruction and domination of the post-war world.

Yet it is not accurate to counterpose, as some analysts have done, Soviet military interest in a "warfighting" and hopefully "war-

winning" capability to a "deterrent" capability. The Soviets see the former as providing the most credible deterrent, as well as serving as a contingent resort if war should nonetheless come. In fact, the Soviets do conceive of some manner of strategic balance -- and thus deterrence -- existing between the United States and the Soviet Union. The Soviets maintain that the principal role of their military power has consistently been to dissuade imperialist powers from resort to <u>their</u> military power against the Soviet Union. Deterrence in Soviet writings is usually expressed in terms of a Soviet assured retaliatory capability which would devastate the aggressor, because this formulation (rather than "mutual" assured destruction) is more compatible with the Soviet ideological position that the Soviet Union will not be the aggressor and thus does not need to be deterred.

The result is that (not unlike the U.S.) the Soviet leadership continues to look in the first instance and final account to its own unilateral military strength as the guarantor of deterrence of the other side. Soviet military power, and the constant enhancement of its capability and readiness, is thus justified primarily for deterrence, but also to wage a war should one come despite Soviet efforts to prevent it. To quote Marshal Grechko,

> "Imperialism is still in a position to throw the nations into the abyss of a new world war. One must be vigilant every day and every hour, that is why the Communist Party is constantly concerned with strengthening the States' defensive capability and with increasing the combat might of the armed forces. Their high state of combat readiness serves as an important guarantee of peace and security ... (3)

As General Bochkarev explained:

> "the military might of the Soviet Union...deters imperialism, but does not create an absolute guarantee against...war. War, while deterred and unlikely, is not seen as inconceivable, and it must be prepared against with vigilance and with capabilities sufficient to repel aggression." (4)

It appears that the Soviets translate these objectives into the need to create a balance in which the correlation of forces is favorable to the Soviet Union and leaves no doubt in the mind of the rational aggressor both for the purpose of deterrence and in the event that deterrence fails. Moreover, the Soviets view the balance as a dynamic one. Soviet generals often cite a statement made by General Secretary Brezhnev in 1970s:

> "We have created strategic forces which constitute a reliable means of deterring any aggressor. We shall respond to any and all attempts from any quarter to obtain military superiority over the Soviet Union with a suitable increase in military strength to guarantee our defenses. We cannot do otherwise."

There is no reason to suspect that the calculus underlying these ideas will change.

What capabilities will these concepts of war-fighting and deterrence demand in the future? Relatively recent Soviet acquisition of hard target kill capabilities, as well as other evidence of technological progress, indicate a new trend in Soviet force posture developments. Whereas, previously, formidable technological difficulties relegated the Soviets to a position of countering U.S. technological superiority with quantity of weaponry, they are now steadily moving in the direction of achieving a force with counterforce capability as well as greater flexibility, survivability and capacity for damage limitation. Nor is this trend towards emphasizing increasing quality rather than quantity likely to be altered.

The greatly increased prospect for the emergence of an enhanced U.S. counterforce capability now appears as a significant challenge to the Soviet ability in the relatively near future to sustain an assured retaliatory and war-fighting capacity as they define these. The Soviets may well be facing a future situation in which they will perceive themselves at both a political and a military disadvantage, if the MX, Trident, and advanced bombers (particularly, perhaps, Stealth aircraft) are deployed in the numbers under discussion in the United

States. In Western Europe, the MIRVing of the British and French SLBMs together with the deployment of LRINF would add significantly to the counter-military capabilities arrayed against the Soviets. In addition, the threat from China, as it acquires greater nuclear capabilities, will become more acute. As Soviet planners look to the future, therefore, they may well fear that their forces will become hostages to the diversity of threats that confront them and that the dynamics of the strategic relationship will work to their disadvantage. The questions, for the purposes of the present study, are what role they may consider for negotiated arms limitations in dealing with the problems they foresee and how the United States could influence that view of arms limitation's role.

3.3 ARMS LIMITATION IN SOVIET NATIONAL SECURITY POLICY

Participation in arms limitation negotiations is one of a variety of means by which the Soviets set out to achieve national security objectives in an uncertain environment. Faced with the strategic imbalance of the 1960s, the Soviet Union appears to have entered the SALT era with the fundamental objective of retaining sufficient freedom of action to be able to continue their strategic force development plans in pursuit of, at the minimum, a robust parity, while focusing their negotiating approach on an effort to impose the maximum restrictions on those U.S. developments judged most threatening by Moscow. The U.S. proposals made in 1967 and 1968 to hold bilateral strategic arms limitation talks (SALT) appear to have coincided with internal Soviet consideration of the implications for their own security and for their future military programs of the prospect of attaining parity with the United States. For the Soviet Union, parity meant the achievement for the first time of a massive second strike capability and greatly enhanced their security not only against a possible American first strike, but also against diplomatic-military pressures supported by the superior American "position of strength" based on its monopoly of a secure second strike capability.

Evidence of this Soviet perspective was presented with great clarity in 1976 by one of the leading Soviet commentators on the Soviet-American strategic relationship, Dr. Genrikh Trofimenko, in the following passage:

> In his time, when McNamara advanced his theory of "deterrence" or "mutual deterrence" by means of a second strike dealing "unacceptable losses", he conceptually postulated parity in the capability of the two sides for "mutual assured destruction." The Pentagon leaders, however, calculated privately that the U.S. had greater capabilities in the sense that only the U.S. had a "full-valued capability" for a second strike, while the U.S.S.R. disposed of such a capability only conditionally, "in embryo", and that this imbalance in fact and in real capabilities (with their parity theoretical) gave the U.S. an opportunity to translate it into "tangible political advantages," continuing a policy of pressure "from positions of strength" against the U.S.S.R. But no matter what illusions American strategists built on this calculation in the 1960s, and no matter what political capital they attempted to draw from it, the 1970s completely shattered such hopes: in the U.S. now no one doubts that the U.S.S.R. can deal "unacceptable losses" in a second strike even under circumstances of a massive American nuclear attack on the Soviet Union. (5)

There can be no doubt that the Soviet leadership perceived that agreed arms limitation could make a significant contribution to reducing otherwise necessary military efforts. Limitations could function in the short-term to permit greater concentration of effort on more important programs, and in the long term as an aid in shifting the correlation of forces in the Soviet favor. This point is well illustrated by the series of articles entitled "Navies in War and Peace" published by Admiral Gorshkov in 1972/73, straddling the conclusion of the SALT I agreement. (6) Gorshkov commented on the contemporary experience of arms limitation negotiations by reference to the historical record of the successive naval arms limitation efforts of the period between the two World Wars. Gorshkov's principal theme in discussing the naval arms limitation conferences is the gradual rise of U.S. naval power and the parallel eclipse of the British navy. By way of summary of the period, Gorshkov comments:

> "The Americans have succeeded without a war (with Britain) in achieving what Germany could not achieve with two world wars."

Following what Gorshkov termed "the war of the diplomats for supremacy at sea",

> "...the United States achieved international recognition of the "parity" of its naval forces with the British forces...However, Japan, Italy and later Germany, not having achieved by the diplomatic route the armament relationships which they desired and favorable positions for themselves in world markets, continued to prepare feverishly for war."

Significantly, Gorshkov's description of the "war of the diplomats" appeared in the first of the articles in the series to be published after the signing of the SALT I agreements. By implication, his view of arms control negotiations was that of an adversarial process in which the participants sought to enhance their relative positions.

There is, therefore, good reason to believe that the Soviet leadership has increasingly come to accept that negotiated strategic arms limitation can be a means of achieving their strategic objectives at lower budgetary and political cost. However, the conditions in which, and the criteria by which, specific arms limitation proposals are judged to be in the Soviet national interest and, in particular, the role which different possible U.S. strategic force policies and programs play in this judgment remain to be clarified.

In contrast to the competitive, somewhat adversarial quality of the weapons technology development/procurement and arms limitation decision-making processes in the United States, great compatibility between the two processes is apparent in Soviet decision-making. Close coordination of arms limitation and procurement is facilitated by the Soviet bureaucratic organization, in which the structure and centralization of authority ensure a highly integrated decision process. Close supervision of both aspects of policy at the highest levels of authority suggests that discrepancies are reconciled in the same forum, thus ensuring conformity with the broader aims of policy. At these highest

levels the structure and distribution of power has in recent years favored military interests. Moreover, the stability of the leadership over time has afforded continuity in both procurement and negotiating strategies, which also facilitates steady pursuit of long term goals. Finally, at the lower levels of the bureaucracy, highly formalized channels facilitate staffing and the provision of information and analysis to the decision-making echelons.

The nucleus of Soviet defense decisionmaking is the Politburo and its ad hoc subgroup on national defense. At present, the membership of this latter body reportedly includes Brezhnev, Ustinov (Minister of Defense), and Kirilenko (a close Brezhnev supporter). As the supreme policymaking body of the Soviet Union, the Politburo has final authority over all decisions of national importance. Centralization of power, in combination with Soviet bureaucratic conservatism, tends to require the direct intervention of political leaders in a wide variety of issues. The demands placed upon the Politburo are enormous in scope and in detail. In particular, memoir literature of the Stalin and Khrushchev period attests to the fact that the Politburo has been directly involved in most major weapons development and procurement decisions. It is most probably in that forum that final reconciliation of negotiating positions and defense procurement issues occurs. For example, during the Kissinger-Brezhnev summit meeting of March, 1974, a Politburo meeting was called hastily to discuss the ramifications of new possibilities in SALT. In October of that year, meetings between Kissinger and Brezhnev concluded with a special Politburo meeting, following which the Soviets agreed on the critical issue of equalizing aggregate numbers of strategic delivery vehicles.

Brezhnev's ruling style, which combines the preeminence of his personal power with decisionmaking through collegial consensus,

appears to be to avoid new and divisive policy proposals in favor of previously negotiated positions. In this context and with these constraints, the way in which issues are framed and the sources of information and analysis become vital to the entire decisionmaking process. Thus, although the Politburo holds the final deliberations and makes the final decisions on both arms limitation and procurement policy, it depends heavily on the inputs it receives. In practice, although civilian sources, including research institutes, are available to provide inputs on many of the questions at issue, the majority of the analysis is either provided or heavily influenced by the military.

Military influence on the decision-making derives from various sources. Perhaps the most important is membership of most top level bodies. The primary agency responsible for the formulation of military policy and doctrine is the Defense Council (Sovyet Obornoy) which, although subordinate to the Presidium of the Supreme Soviet, links politicians and the military at the highest level. The council has a broad mandate as the "leadership of the country's defense", and occupies itself primarily with decisions concerning major weapons development and procurement programs, manpower and budgetary allocations, assessed in the light of changing doctrine and perceptions of threat.

A high percentage of the Defense Council's members, which are said at present to include Brezhnev, Ustinov, Kirilenko, Gromyko, and Andropov, normally also serve on the Politburo. This overlap both facilitates cooperation between politicians and the military and suggests a broad consensus on important military matters. In addition, it indicates that the military establishment has significant access and input to deliberations regarding even the most routine military decisions at the highest levels. The Council may also provide a forum in which the net effects of various arms control strategies are analyzed in relation to both doctrinal goals and their impact on force

structure objectives. Thomas Wolfe argues that, during the SALT negotiations, the Defense Council became the chief instrument through which political authorities became involved in the technical aspects of military decisionmaking and the forum in which final policy decisions on SALT appear to have been resolved on behalf of the Politburo as a whole. This further illustrates the primacy of military goals and the non-competitive, subordinate role that arms limitation plays in the achievement of those goals. (7)

Working directly in support of the Defense Council, the Soviet General Staff (Generalnyi Shtab) holds the key to the weapons requirements process as a result of its monopoly of strategic analysis and operations research and its control of the various service branches and operational forces. The responsibility of the General Staff includes the development of a "unified military strategy" based upon the goals established by the Politburo and the Defense Council.

The bulk of the military support work for SALT has probably been handled by various components of the General Staff. The Main Intelligence Directorate (GRU) of the Staff is likely to be the primary source of intelligence collection and analysis on U.S. strategic capabilities. Its efforts are no doubt supplemented in the collection area by the work of the KGB and, in the analytical field, perhaps by the staffs of the weapons production ministries operating under the direction of the Military-Industrial Commission (currently chaired by L. V. Smirnov) or the Defense Industries Department within the apparatus of the Central Committee (currently headed by I. D. Serbin).

The nerve center of the General Staff, the Main Operations Directorate, also plays multiple roles in SALT. It has an Arms Control Section, which is probably the primary military agency for monitoring the progress of the negotiations themselves. The Operations Directorate is also responsible for providing information to the leadership on the status of both deployed Soviet strategic forces and the new weapons

systems under development. By virtue of its functions of interpreting intelligence, framing problems, and providing analysis, the General Staff, therefore, occupies a central and essential link in the decisionmaking chain.

The leading role in the actual conduct of negotiations has been played by the Ministry of Foreign Affairs. However, despite initial military skepticism and hostility toward SALT, the military came to play a more prominent role in the negotiations as they became increasingly technical and began to focus on questions with greater potential for imposing limits on Soviet weapons development and deployment. In the SALT talks, the military provided approximately one-third of the Soviet delegation, including, during the opening phases of SALT I, the number two negotiator (and subsequently Chief of the Soviet General Staff), Colonel General N. V. Ogarkov. Thus it would appear as though the foreign policy ministries have been relegated to providing advice on the impact of different options on Soviet external relations and performing technical/legal functions associated with the creation of agreements.

Representatives of another institutional group have appeared on the negotiating team during SALT. Men connected with the weapons development and production centers of Soviet science and industry at the academician and deputy minister levels were included among the members of the delegation. Moreover, L. V. Smirnov, the current chairman of the Military-Industrial Commission, who plays a prominent role in coordinating defense production, emerged to play a central part in the final rounds of bargaining at the Moscow summit in May 1972, which culminated in the signing of the ABM Treaty and again during the SALT portions of the Vance mission to Moscow in March 1977. These participants, representing the defense production ministries, are likely to be called upon to provide both technical analyses of adversary weapon capabilities and to assess the possible impact of restraints upon Soviet development and deployment programs.

While, therefore, the position the Soviet Union adopts in a particular negotiation is no doubt partly the result of competitive bargaining among institutional players in the government hierarchy, a process which in some respects is similar to that in the United States, results are influenced importantly by a number of factors peculiar to the U.S.S.R. Of these, two are of particular importance. First, there is no entity involved in the process which has arms limitation as its raison d'etre, such as the Arms Control and Disarmament Agency in the United States. This has apparently prevented the growth of an organized arms control interest group within the Soviet system. Second, the bureaucracy appears to share a broad consensus about the primacy of military policy goals. This creates a policy environment particularly receptive to the interests of the military and to the protection of weapons programs judged essential by the military from arms limitation constraints.

While the strength of military influences on Soviet policy cannot be doubted, it should not be assumed, as some experts have contended, that Soviet leaders have simply left open-ended the question of "how much is enough". The general Soviet concept of the correlation of forces is a broad one which encompasses the total strength of the nation in all its attributes -- military, industrial, agricultural, social, political and economic -- in juxtaposition to that of the United States or the West in toto. For example, in a 1979 discussion of the "objective possibility" of Soviet victory in global war, Marshal Ogarkov, by then the Chief of the Soviet General Staff, gave as much prominence to the relative strength of Soviet society as to the strength of the armed forces themselves:

> "The Soviet Union ... (in the case of war) ... will have definite advantages over the imperialist states caused by the just aims of the war, the advanced character of (its) social and state order. This provides... the objective possibilities for achieving victory. However, for the realization of these possibilities the timely and many-sided preparation of the country and armed forces is necessary." (8)

Within the framework of the overall correlation of forces, the correlation of Soviet and U.S. strategic forces is but one variable, albeit one of paramount importance. Thus, superiority in the correlation of forces between east and west, comprising as it does a range of different elements, does not necessarily demand superiority in strategic forces or at least not in each element of these forces. The elements of time and expected interaction with U.S. policies are both important in this connection. Soviet behavior over the post-war period shows a realistic appreciation of the fact that major strategic objectives cannot necessarily be attained rapidly and that progress toward them is dependent on the solution of complex problems of technological development and production. At the same time, Soviet planners cannot expect, any more than their U.S. counterparts do, that U.S. strategic programs will stand still while they attempt to achieve some particular set of capabilities relevant to a given strategic objective. While some of these capabilities may be insensitive to U.S. countermeasures, others (e.g. the capability to destroy land-based ICBMs with high confidence) are assuredly not.

Similarly, while Soviet strategists may in theory believe in the importance of decisive superiority, according to some measure, in the correlation of intercontinental strategic forces vis-a-vis the United States, they are no more likely than their U.S. counterparts to believe that such superiority can in practice be durably attained by one side or the other short of a much greater disparity in economic investment than is currently on the horizon.

Finally, just as the Soviets see the strategic relationship as being a dynamic one, the maintenance of which requires constant effort, they can expect to take a similar view of arms limitation agreements. At the time at which they enter into such an agreement, the Soviet leadership must judge that the balance of advantage and disadvantage of doing so in terms of Soviet strategic objectives is positive. Whether or not that judgement remains valid over time depends

on several factors, among them the development of Soviet technology and forces and U.S. actions. In certain circumstances, the Soviets might see the prospect of greater U.S. technological progress as threatening to erode the Soviet strategic position in the absence of an arms limitation agreement. Thus, as was suggested in Chapter 2 in connection with the ABM Treaty, the United States does have at least one element of leverage over Soviet judgements about the importance of a given arms limitation agreement, even after it is ratified, should it choose to use it.

It would be quite consistent with this view, and with those of Admiral Gorshkov and Dr. Trofimenko cited earlier, to see arms limitation agreements as a means of stabilizing or channelling the U.S./Soviet strategic relationship during periods in which Soviet attainment of important objectives is constrained either by technological problems in the U.S.S.R. or by the momentum -- potential or actual -- of U.S. strategic programs. Whether agreements which satisfied these criteria on the Soviet side would or, in U.S. terms, should be acceptable to the United States would, of course, have to be considered and explored case t case. But the evidence does not support a prima facie case that the Soviets would automatically rule out the possibility that agreements which were seen as advantageous by both sides in the light of their different strategic purposes could be found. This is true even though the Soviets may prefer to think in terms of zero-sum outcomes which favor the Soviet Union at the expense of the United States and the use of the negotiating process to inhibit U.S. defense efforts (an approach which their recent experience with SALT II may have made them view as less promising, at least for a time).

In this context, arms limitation, while not to be considered as a useful end in itself, can be valuable to overall Soviet strategy insofar as it can be used as a vehicle for alleviating, even if it cannot solve, substantive military and economic problems, as well as

providing positive foreign policy effects. This implies that Soviet interest in the subject matter of negotiation is likely to evolve over time as new technological capabilities, foreign events, or economic priorities emerge (or, as a Soviet observer would see it, as the correlation of forces changes).

A final issue which needs to be considered in tnis connection is the possible relevance of the Soviet five year planning cycle to the interaction between defense procurement and arms limitation policy decisions. This question is raised by a body of work, most notably by Dr. John Sell (9), which suggests that the full-scale procurement authorization of Soviet weapons systems coincides with the beginning of five year planning cycles. It might then be inferred from this cyclical process that the period of preparation of a Soviet five year plan would be one in which there would be the greatest flexibility in the Soviet system for accepting arms limitation proposals, whereas at other times the prospects for arms limitations which actually constrained Soviet programs would by comparison be poor.

There is, however, little evidence to support this hypothesis. In the first place, the correlation between the five year planning cycle and the timing of key decisions about the development and deployment of major Soviet strategic weapons systems is open to challenge. Unclassified data on this subject, which is obviously subject to considerable imprecision, are displayed in Figure 3.1. Moreover, in the light of the preceding analysis, the critical point would seem to be the fact that any Soviet decision of consequence concerning arms limitations would be taken at the highest levels. The existence of a program in a five year plan would be unlikely to stand in the way of an agreement which the Politburo judged to be in the overall Soviet strategic interest. The history of the SS-16, which is discussed below, would be argued by some to be a case in point. However, the full-scale engineering development authorization of a weapons system, whether or not it normally forms part of the preparation of a new five year plan,

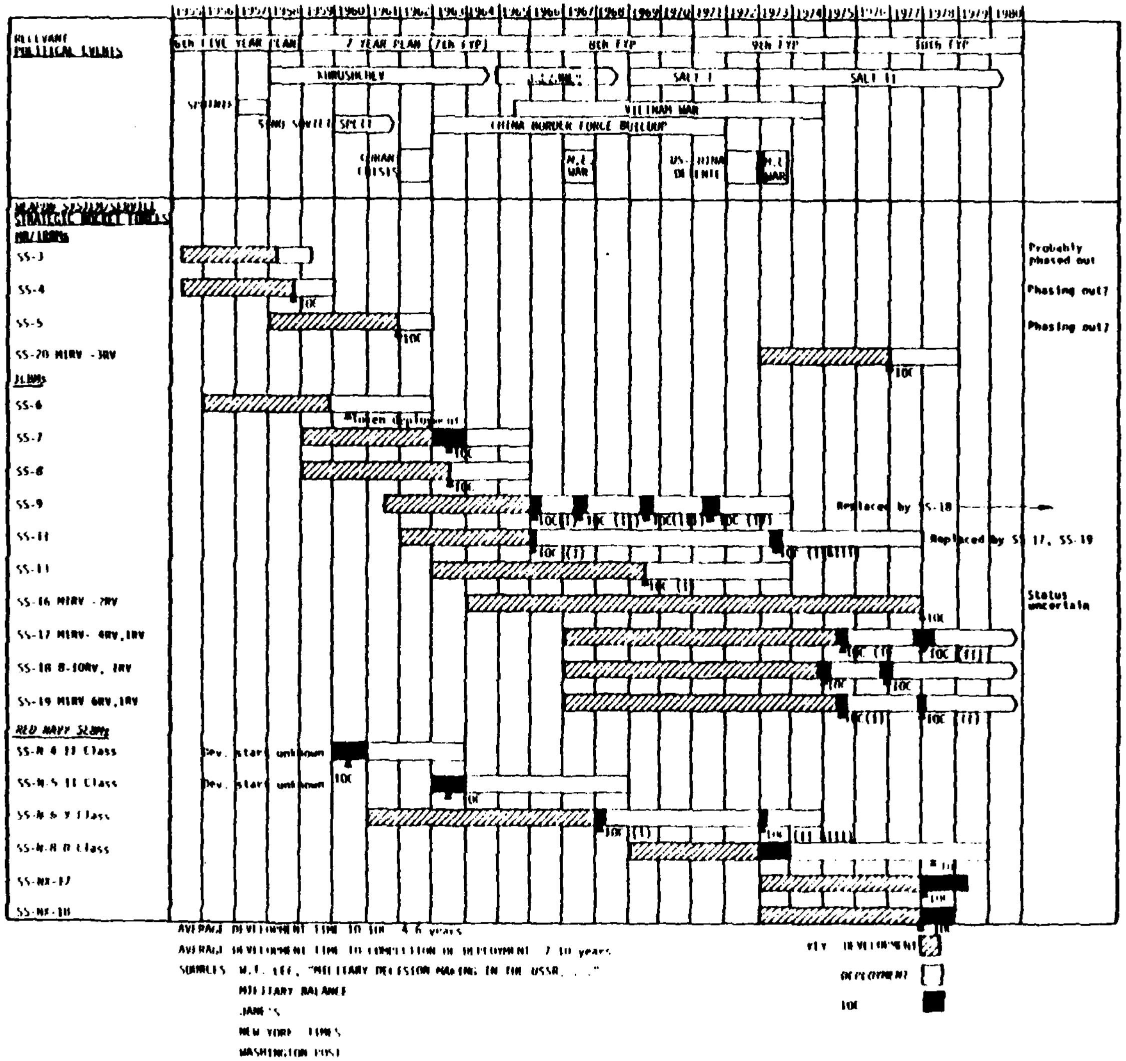

Figure 3.1: Development, IOC and Deployment of Soviet Strategic Missile Systems, 1955-80.

undoubtedly adds to its bureaucratic momentum and makes its curtailment or cancellation harder. On the basis of the available evidence, the hypothesis concerning technological momentum advanced in Chapter 2 provides at least as satisfactory a model for the analysis of future Soviet interest in arms limitation proposals affecting the military application of new technologies as the hypothesis that the climate surrounding the preparation of the five year plan is especially propitious for arms limitation negotiations.

3.4 SOVIET ARMS LIMITATION BEHAVIOR OBSERVED

3.4.1 Introduction

In order to explore in more detail the ways in which, and the criteria according to which, the Soviet leadership judges the acceptability or otherwise of particular arms limitation proposals, the cases reviewed and the hypotheses advanced in Chapter 2 were further examined, with a particular focus on Soviet behavior and decision-making. Of the five cases, two (European theater arms limitation and CW) are not discussed below because they are not directly relevant to the question at issue. The other three are discussed in turn in Sections 3.4.2, 3.4.3, and 3.4.4. A final section, 3.4.5, reviews all the limitations on freedom to exploit technology accepted and rejected by the Soviet Union in SALT to date.

3.4.2 ABM

The initially low level of Soviet interest in starting SALT negotiations in late 1967 and early 1968 may be attributed to leadership preoccupation with the extensive offensive military build-up of strategic systems that they had undertaken and the optimism they still felt about their ability to develop and deploy an effective ABM system. No compelling incentive for the talks was present as the Soviets rapidly approached quantitative parity with the United States in ICBMs, while

U.S. numbers remained static and the heated internal debates about U.S. deployment of ABMs persisted. The eventual Soviet decision to start the talks came in conjunction with several events. Evidence suggests that the Soviets indicated their interest in convening the talks on the same day the decision to invade Czechoslovakia was taken. This action has been interpreted, probably accurately, as a facile attempt to mitigate the U.S. reaction to the invasion.

But there were reasons other than such tactical ones for the Soviet change of heart to survive the Czechoslovak crisis. The decision of the Nixon Administration to push ahead with the Safeguard, rather than Sentinel, system caused apprehension within the Soviet military-industrial establishment. Hard-site protection of U.S. ICBM launchers was evidently considered in Moscow a far greater threat to Soviet strategic interests than the light protection of U.S. cities. Taken together with the U.S. MIRV program, Safeguard was an extremely significant development. By this time, the Soviets had encountered substantial technical setbacks with their ABM program, although they had already started deployment of the Moscow system. The problems were apparently so acute that they planned to limit deployment severely. The U.S. Safeguard system represented a significant technological advance over the Soviet design. Thus, U.S. developments appeared to call into question the credible deterrent which the Russians were finally in the course of deploying: MIRV could easily defeat the Soviet ABM system, and the U.S. could deploy a better ABM for its own defense needs, before Soviet MIRV testing had even begun. The Soviets perceived that their precarious attainment of parity and an assured retaliatory capability could be easily upset. In 1968, General Zemskov claimed that the "nuclear balance" which existed would be easily disrupted by:

> "The creation by one of the sides of highly effective means of anti-ballistic missile defense while the other side lags considerably in solution of these tasks. A change of the "nuclear balance" in favor of the countries of imperialism would increase greatly the danger of a nuclear war." (10)

There is a clear relationship between this discussion and the Soviet decision, taken by that time and soon to become evident in SALT, that ballistic missile defenses of the two sides should, if possible, be sharply limited through an arms limitation agreement so as not to risk restoring the United States to a position of superiority. From the Soviet point of view, therefore, the ABM case shows how the interaction of a U.S. technological advantage and Soviet strategic objectives (in this case, the maintenance of an assured retaliatory capability so painstakingly acquired during the 1960s) could add up to a reason for arms limitations, at least for a time. This combination of incentives perceived by the Soviets in 1972 was of course subject to change in the light of subsequent events (Soviet development of MIRV, relative U.S./Soviet progress in ABM development). But for the time, at least, it justified accepting the ABM Treaty on grounds directly related to Soviet military objectives.

3.4.3 MIRV

There is little doubt that the Soviet Union appreciated the significance of the MIRV systems which the United States was testing by 1969. The Soviets could see that what they had gained toward quantitative parity of launchers was soon going to be forfeit to the multiplication of U.S. warheads. It was also apparent to them that it would be perhaps a decade before their own large-scale MIRV deployments would be possible. With the United States rapidly nearing deployment, the Soviets must have looked to the initiation of the SALT talks as a way of slowing or stopping U.S. progress without impeding their own. A MIRV ban on appropriate terms was obviously considered to be one means of achieving that objective. There was no doubt disappointment at the U.S. MIRV ban proposal, the sincerity of which the Soviets probably questioned. One of the primary motivations for Soviet participation in SALT was to register Soviet equality in offensive weapons and, to the Soviets, the prospect of MIRVs offerred a cost effective way of making

progress towards the strategic objective of a damage limiting strategic force capability (a goal which may have been implicit in the U.S. program, but was never recognized as U.S. policy). A MIRV ban could therefore only have been acceptable to them if it permitted testing and development of the technology which would allow them eventually to achieve technological parity. This rationale determined the content of the Soviet counterproposal, which suggested banning the production (but not testing) of multiple warheads of any kind, as well as their installation in missiles, with verification solely by NTM. As described in Chapter 2, this alternative was unacceptable to the United States.

However, it subsequently became clear that, in the absence of a Soviet-style MIRV ban, there was no basis, from the Soviet perspective, for any substantial limits on the Soviet offensive weapons program. The Soviets were sufficiently far behind the United States in MIRV technology that U.S. programs to MIRV SLBMs and ICBMs, for the immediate future, could only be matched by having substantially larger numbers of launchers. Without a MIRV ban, there was nothing to recommend severe limitations on offensive weapons. As former SALT negotiator Gerard Smith emphasized,

> "MIRV was the decisive asymmetry which ultimately prevented reaching meaningful controls over offensive forces in SALT I." (11)

This episode demonstrates clearly the Soviets' unwillingness to lock themselves into a position of inferiority vis-a-vis the United States by banning the testing of a fundamental new weapon system whose technology they had not yet mastered, but whose potential strategic significance for the Soviet Union was considerable. Additional support for the technological asymmetry hypothesis is the fact that, seven years after the start of SALT, when the Soviets had mastered MIRV technology and were deploying MIRVed missiles, they agreed in SALT II to a limit on offensive strategic launchers, including a sublimit on

MIRVed missile launchers at equal, though high, levels. The first arms limitation window, for prohibitions, had been missed.

3.4.4 Cruise Missiles

There were several reasons for the Soviet Union to have been interested in negotiated limits on long range cruise missiles. The degree of U.S. interest in developing cruise missiles had changed markedly from the SALT I period and this created a growing anxiety in Moscow. Both countries had previously deployed primitive cruise missiles -- the United States in a variety of modes. Evidence of potential U.S. breakthroughs in TERCOM guidance and light weight turbofan engines began to presage major U.S. deployments. Soviet cruise missile technology, however, had remained a low priority item. In fact, the Soviets appear to have had little incentive to compete with the United States in long range CM technology since they had relatively few missions for long range systems that would not be better served by other systems, notably MIRVed ICBMs, with their advantage in penetration probability over cruise missile-carrying bombers. Given a Soviet judgement that the United States would wish to retain an air-breathing strategic force and the importance the Soviets place on air defense, a cruise missile limitation would have been a desirable means of containing U.S. capabilities to saturate air defenses. This appears to have been the initial Soviet incentive for the establishment of 2500km range limits on cruise missiles and their willingness to make some concessions to U.S. insistence on obtaining at least some limitations on the Backfire.

As noted in Chapter 2, the CM case supports the view that a U.S. lead in the application of an important technology can provide a compelling incentive for the Soviets to engage seriously in arms limitation discussions. But in fact, as suggested above, this was a case in which the proposed limits probably would have had little effect on Soviet strategic requirements.

3.4.5 Limitations on the Application of Technology Accepted or Rejected by the Soviet Union in SALT

In addition to the major cases reviewed by the study, a larger list of cases in which the Soviets eventually accepted limitations on technology applications during the SALT negotiations was compiled. This list is shown in Figure 3.2. Many of these limitations were introduced into the negotiations primarily to close theoretical, but in practice unattractive, means to circumvent the intent of the major limitations. Acceptance of them represented little more than a willingness to accept the logical consequences of the major limitations.

More interesting, perhaps, are several cases in which the Soviets rejected limitations on the application of technology. The most important of these are discussed below.

- Ban on deployment of land-mobile ICBM launchers. Proposed by the United States at a time when the Soviets were developing, but not yet flight-testing, land-mobile ICBMs, the Soviets rejected the proposal, arguing that limiting mobile ICBMs should be a subject for discussion in a future negotiation. This position reflected the fact that the SS-16/SS-20 was in an advanced state of development, but not yet in the testing phase. The technology involved in making a mobile missile was not profound, however. The United States already had one -- the Pershing -- and Soviet momentum was well beyond the threshold. Nevertheless, the Soviets did in the end accept an effective delay in the deployment of a Soviet land-mobile ICBM by agreeing to Article IV.8 of the SALT II agreement, which prohibited the deployment of the SS-16 and to Article I of the Protocol, which prohibited flight-testing and deployment of mobile ICBMs until December 1981, though the precise reasons for this decision (whether unhappiness with the system or a real sacrifice made in order to reach an agreement) are unclear.

- Ban on deployment of "Exotic" ABM systems. Proposed by the United States in 1971, the Soviets argued that it was not appropriate or reasonable to include provisions on undefined systems, and that the provisions for ABM Treaty review and amendment were sufficient. Since many of these prospective technologies were not even on paper, there was a strong incentive to reject limits. However, in 1972, this issue (to

Figure 3.2: LIMITS ON FREEDOM TO EXPLOIT TECHNOLOGY ACCEPTED BY THE U.S.S.R. IN SALT AGREEMENTS

Article & Paragraph	Agreed Statement	Common Understanding		1 System upgrade	2 System ban	3 Design/commonality	4 Testing practices	5 Operational practices	6 U.S. most constrained	7 USSR most constrained	8 Robust goal	9 Quality effect
				TYPE OF LIMITATION					EFFECTS OF LIMITATION			
			SALT I - ABM TREATY									
V.1			No development, testing, or deployment of sea-based, air-based, space-based, or mobile land-based ABM systems or components		•						•	? b
		D	Definition of mobile system: radars or launchers are not permanent, fixed types			•				•		
V.2			No development, testing, or deployment of multiple ABM launchers or rapid reload launch systems		•						•	? b
	F		No development, testing, or deployment of multiple warhead ABM missiles		•						•	•
VI a			No upgrade to ABM capability of non-ABM missiles, launchers, or radars, and no testing in an ABM mode	•			•				•	
VI b			No BMEW radars except on periphery of territory and oriented outward	•				•			•	
—	D		No other non-ABM large phased array radars except for space-track and ICIM purpose		•						•	
	C	B	ABM deployment areas for NCA and ICBM defense to be separated by at least 1300km					•			•	
	E		If future ABM systems based on other physical principles developed, limitations will be subject to negotiation and agreement	•				•			•	
XII.2			No interference with NTM					•		•		
XII.3			No deliberate concealment which impeded NTM				•	•			•	
			SALT I - INTERIM AGREEMENT									
II			No conversion of launchers for light or older ICBMs into launchers for modern heavy ICBMs	•						•		• (a)(b)
—	J		No significant increase in ICBM silo dimensions	•						•		• (a)(b)
—		A	Definition of significant increase: 10-15%	•			•			•		• (a)
	L		No conversion of test range launchers for purposes other than testing and training				•	•		•		? a
V.2 V.3			Same limitations on interference with deliberate concealment from NTM as in ABM Treaty									
				1	2	3	4	5	6	7	8	9

KEY: (a) Imprecision or loopholes in limitations.
(b) Lack of technological momentum, i.e., no active program in-being or systems obsolescence

NOTE: For a complete listing of all SALT II provisions, agreed statements, and common understandings, including quantitative and other restrictions not directly affecting technology exploitation, see Sauerwein et al. A study of the Impacts on U.S. Strategic Weapon Systems of the SALT II Treaty, SAI, 31 March 1980, Volume I, Appendix A.

LIMITS ON FREEDOM TO EXPLOIT TECHNOLOGY ACCEPTED BY THE U.S.S.R. IN SALT AGREEMENTS (continued)

Article & Paragraph	Agreed Statement	Common Understanding		TYPE LIMITATION: System upgrade (1)	System ban (2)	Design/commonality (3)	Testing practices (4)	Operational practices (5)	EFFECT OF LIMITATION: U.S. most constrained (6)	USSR most constrained (7)	About equal (8)	Little effect (9)
II.2	1	2	Type rule: All launchers of a type developed and tested for ICBMs count as ICBM launchers	●		●				●		
		1	"Contains or launches" equals "developed and tested"				●				●	
II.3	4		Heavy bomber type rule, including ALCM and ASBM carriers, with exceptions for airplanes with FRODs and ODs	●		●					●	
		1	Definition: FRODs are observable differences indicating whether or not airplanes can perform specific missions			●					●	
		2	FRODs required on Bison tankers	●		●		●		●		● b
II.5	1	2	Type rule: All launchers of a type developed and tested for MIRVed ICBMs or SLBMs count as MIRV launchers	●		●				●		
		1	"Contains or launches" equals "developed and tested"				●				●	
	2		One flight-test with MIRVs makes an ICBM or SLBM a MIRVed type, other payloads not withstanding			●	●			●		
		4	All Soviet ICBM launchers at Derazhnya and Perromaysk count as MIRVed			●				●		●
		5	ODs required for future MIRVed ICBM launchers and for submarines with MIRV launchers			●					●	● a
II.6	1		One flight-test with MIRVs makes an ASBM a MIRVed type, other payloads not withstanding			●	●				●	● b
II.7 II.5	1 3		Definition: heavy ICBMs are ICBMs having launch-weight or throw-weight greater than that of the heaviest existing light ICBM, i.e. the SS-19	●							●	
II.8	1		Type rule for counting cruise missiles with ranges >600km	●		●					●	
		1	One flight-test >600km equals cruise missile with range >600km			●	●				●	
		2	ODs required for cruise missiles with ranges <600km			●					●	● a
	2		Definition of cruise missile range			●	●				●	● a
	3		Type rule for counting armed cruise missiles	●		●					●	
		3	ODs required for unarmed pilotless guided missiles			●					●	● a
		4	No conversion from unarmed to armed or vice versa			●					●	? b
		5	Advance notification required if a Party intends to flight-test or deploy an unarmed, pilotless, guided vehicle with ranges >600km on aircraft, except for target drones			●					●	

LIMITS ON FREEDOM TO EXPLOIT TECHNOLOGY ACCEPTED BY THE U.S.S.R. IN SALT AGREEMENTS
(continued)

Article & Paragraph	Agreed Statement	Common Understanding		TYPE LIMITATION: System upgrade 1	System ban 2	Design/commonality 3	Testing practices 4	Operational practices 5	EFFECT OF LIMITATION: U.S. most constrained 6	USSR most constrained 7	About equal 8	Little effect 9
III.4			Type rule: All ASBM carriers credited with maximum number of ASBMs for which type equipped	•		•	•				•	• b
IV.3			Same ban on conversion of light and older ICBM launchers to modern heavy ICBM launchers as in SALT II.A									
IV.4			Increases in volume of ICBM silos limited to 32%	•							•	• a
IV.5			No rapid reload capabilities for ICBM launchers and no excess missiles at launch sites or deployment areas			•		•		•		? a
IV.7			Upper limit on launch-weight and throw-weight of heavy ICBMs, i.e. those of SS-18	•						•		? b
IV.8			No conversion of non-ICBM launchers to ICBM launchers	•						•		? b
		1	No production, testing or deployment of the Soviet SS-16 ICBM		•	•				•		? b
IV.9			Each side limited to one new type of light ICBM		•					•		
	1	1	Definition: new type differs from an existing type in number of stages, type of propellant, or more than 5% in length, diameter, launch-weight or throw-weight	•		•				•	•	?(a, b)
	2	2,3,4	Limits on changes to permitted new type and other "non-new" ICBMs during flight-testing				•				•	? a
IV.10			No increase in maximum number of RVs on existing types of ICBMs	•						•		
		1	U.S. Minuteman III limited to 3 RVs	•					•			• b
	2		Simulated RV release procedures count as RVs	•			•				•	
	3		Restrictions on reducing weights of RVs and PBVs	•							•	
IV.11	1,2		Maximum number of RVs on permitted new type of ICBM limited to 10, with no increase permitted after 25th launch or deployment if smaller number of RVs is selected	•		•					•	
IV.12	1,2		Max. number of RVs on an SLBM limited to 14, with same rules on changes, simulations as above	•		•		•		•		
IV.13	1		Max. number of RVs on an ASBM limited to 10, with same restrictions on changes, simulations			•	•			•		•
IV.14			Average number of ALCMs per carrier limited to 28			•			•			

LIMITS ON FREEDOM TO EXPLOIT TECHNOLOGY ACCEPTED BY THE U.S.S.R. IN SALT AGREEMENTS
(continued)

Article & Paragraph	Agreed Statement	Common Understanding		TYPE LIMITATION: System upgrade 1	System ban 2	Design/commonality 3	Testing practices 4	Operational practices 5	EFFECT OF LIMITATION: U.S. most constrained 6	USSR most constrained 7	About equal 8	Little effect 9
	1		Type rule: All ALCM carriers credited with maximum number for which type equipped	•		•					•	
	2		Limit of 20 ALCMs per existing type of heavy bomber (including B-1)			•			•			? b
V.4	1		Type rule for MIRV ASBM carriers crediting all with max. number for which type equipped	•		•					•	• b
V.6	1	1	Removal of systems from MIRV/ALCM carrier aggregates required D&D or other agreed procedures			•					•	
VIII .1,2	1	3	No conversion of non-bombers into heavy bombers or carriers of ASBMs or cruise missiles with ranges > 600km, except for up to 16 ALCM or ASBM testbeds having FRODs	•		•	•				•	
IV.1			No development, testing, or deployment of:									
			(a) ballistic missiles with ranges > 600km on surface ships		•						•	• b
			(b) bottom-mounted or crawling underwater missiles		•						•	• b
			(c) orbital or fractional-orbital nuclear weapon systems		•					•		• b
			(d) mobile launchers or heavy ICBMs		•					•	•	? b
			(e) and (f) heavy SLBMs or ASBMs		•						•	• b
IX.2			No development, testing, or deployment of ALCMs with multiple warheads		•						•	• b
XV.2 XV.3		1	Same limitations on interference with and deliberate concealment from NTM as in SALT I ABM Treaty, except to specify that prohibited concealment measures include those assciated with testing.									
XV.3		2	No deliberate denial, including by encryption, of telemetry during testing when it impedes verification				•			•		
		3	No shelters which impede verification over ICBM silos				•	•			•	
XVI.1		1,2	Advance notification of ICBM test launches outside territory, and of multiple ICBM launches				•				•	

LIMITS ON FREEDOM TO EXPLOIT TECHNOLOGY ACCEPTED BY THE U.S.S.R. IN SALT AGREEMENTS
(continued)

Article & Paragraph	Agreed Statement	Common Understanding		TYPE LIMITATION: System upgrade 1	System ban 2	Design/commonality 3	Testing practices 4	Operational practices 5	EFFECT OF LIMITATION: U.S. most constrained 6	USSR most constrained 7	About equal 8	Little effect 9
			SALT II - PROTOCOL (until 31 December 1981)									
I			No deployment of mobile ICBM launchers and no flight-testing of ICBMs from such launchers		•						•	
II.1			No deployment of SLCM or GLCM with ranges 600km		•						•	
II.2			No flight-testing of SLCM or GLCM with multiple warheads		•						•	
			SALT II - SOVIET BACKFIRE STATEMENT									
			No increase in radius of Soviet Backfire bomber, including by refueling, which would "enable it to strike targets on the territory of the USA.	•						•		? a b

the extent that Articles I and II of the Treaty leave it open, which is debatable) was resolved to some degree in Agreed Statement D, which called for discussion and agreement on specific limitations on systems based on "other physical principles".

- <u>Ban on flight-testing and deployment of intercontinental cruise missiles (ICCMs)</u>. Proposed by the United States in 1970, along with the proposal to limit SLCM launchers to those most currently deployed, the Soviets claimed the ICCM ban was irrelevant because all of those systems were obsolete. The proposal was dropped when the Soviets dropped their proposals to limit FBS. Soviet representation of this issue appears to be straightforward. This tends to support the earlier contention that there was little interest in the Soviet Union in cruise missiles at this time; interest was sparked only by the seriousness the U.S. program took on much later.

- <u>Ban on testing and deployment of MIRVed heavy ICBMs</u>. Proposed by the United States in 1973-74, it was rejected because the Soviets were developing, but had not yet flight-tested a MIRVed version of the SS-18.

- <u>Ban on development, testing, and deployment of new types of ICBMs</u>. Proposed by the United States as part of March, 1977 package, and subsequently proposed for the limited period of the Protocol. The Soviets countered initially with a proposal to ban any new MIRVed missiles, and then to ban any new ICBMs except for one new non-MIRV type. The Soviets stated that they wished to replace some obsolete light ICBMs having single RVs (presumably SS-11s) with a more modern non-MIRV system. As the U.S. commitment to the MX grew stronger, the Soviets proposed (in May 1978) a ban on any new ICBM for the entire treaty period, but the United States rejected it. When the IOC date for MX slipped to 1986, the United States proposed in July 1978, a ban on the deployment, but not testing, of any new ICBM for the entire treaty period. With their follow-on ICBM evidently nearer to deployment than this, the Soviets rejected the U.S. proposal. The sides then agreed to permit flight-testing and deployment of one new type of light ICBM, either MIRVed or non-MIRVed. The Soviets sought to limit the number of RVs on a MIRVed type to six, the number on their light SS-19, but accepted 10, corresponding to their SS-18 and the U.S. MX, when the United States insisted.

While none of these instances sheds fundamentally new light on Soviet behavior in arms limitation negotiations, they do, taken with the other evidence, help to fill in a picture of a Soviet system having to make tradeoffs between different interests and options.

3.5 LESSONS FOR THE FUTURE

Given the secrecy which shrouds Soviet decision-making, there can be no certainty about the reasons for which Soviet decisions concerning arms limitation have been taken in the past or those for which future decisions are likely to be taken. In considering whether or not arms limitation should be a part of U.S. policy in specific areas of force posture development in the future, however, it is important to understand as best can be done the calculus of advantage and disadvantage which the Soviets may apply to such issues. For this purpose, the insights derived from the preceding analysis constitute materials to be used in a more detailed examination and net assessment of possible future arms limitation regimes.

The first essential conclusion is that there is little reason to expect any change in the Soviet strategic doctrine which requires that the force posture to be pursued should be oriented toward the effective prosecution of a nuclear war and preservation of the Soviet Union as a national entity and not simply the maintenance of parity or the acceptance of mutually hostage societies as the sole basis for deterrence. Within this context, negotiated arms limitation will be favored to the extent that it eases the attainment of Soviet strategic goals or reduces the threat that the relative Soviet strategic position will be weakened by technological and political change.

As was suggested earlier, the steady technological progress made over the past decade is now permitting the Soviet Union to move away from the quantitative growth of strategic forces toward qualitative improvements in capabilities. Soviet qualitative advances are likely to be directed towards four general strategic objectives:

- accomplishing countermilitary missions
- enhancing force survivability
- increasing operational flexibility
- maximizing damage-limiting potential

Each of these objectives is in consonance with Soviet conceptions of the requirement for deterrence as they were described earlier.

Figure 3.3 contains a list of potential applications of new technology of strategic importance to the Soviet Union, indicating their degree of importance to the Soviet Union and the Soviet strategic force objectives affected by each. Many of these technology applications will be reviewed in more detail in Chapter 4 and discussed in terms of possible arms limitation proposals in Chapter 5. This section will briefly comment on some of the more important of them in relation to the Soviet perspectives and behavior described earlier.

One area which links the past and the future is that of ballistic missile defense. Despite the technological, and consequent force posture, changes which have occurred since 1972, the fundamental question the Soviets face in this area remains the same: whether the negative impact of U.S. BMD deployments on some of their strategic objectives (countermilitary mission, operational flexibility) outweighs the positive impact of Soviet BMD deployments on other objectives (force survivability, damage limiting, including against the growing threat of third country ballistic missiles). And in making this assessment, they face a similar dilemma to that which they faced in the early 1970s in terms of timing, namely that U.S. technology, if unleashed on the BMD problem, might be expected to yield major dividends for the United States sooner than Soviet technology would for the Soviet Union. Thus, even in terms of Soviet strategic objectives narrowly defined, BMD arms limitation continues to present attractions to the Soviets. The balance of advantage and disadvantage that the Soviets

POTENTIAL APPLICATIONS OF NEW TECHNOLOGY OF STRATEGIC IMPORTANCE TO THE SOVIET UNION MID-1980s - 1990s	DEGREE OF IMPORTANCE TO THE SOVIET UNION			SOVIET STRATEGIC FORCE OBJECTIVES AFFECTED			
	VERY HIGH	HIGH	MODERATE	COUNTERMILITARY MISSION	FORCE SURVIVABILITY	OPERATIONAL FLEXIBILITY	DAMAGE LIMITING
<u>ICBM FORCES</u>							
U.S.:							
MX MISSILE	X				X		
MPS BASING	X			X		X	
RVs FOR ABM PENETRATION		X					X
RVs FOR VERY HIGH ACCURACY			X		X		X
S.U.:							
MOBILITY		X			X	X	
PBVs HAVING MORE RVs WITH HTK	X			X		X	
RELOAD/REFIRE CAPABILITY		X				X	
RVs FOR OCEAN AREA AND/ OR BARRAGE AREA FOOT-PRINT			X	X			
RVs FOR ABM PENETRATION OR VERY HIGH ACCURACY		X		X			
<u>SLBM FORCES</u>							
U.S.:							
TWO-WAY SUBMERGED C^3			X				X
HARD TARGET ACCURACY		X			X		
S.U.:							
SSBN QUIETING		X			X		
HARD TARGET ACCURACY			X	X		X	
TWO-WAY SUBMERGED C^3		X			X	X	
DEPRESSED TRAJECTORY SLBMs			X	X			
RELOAD CAPABILITY			X			X	
<u>MRBM/IRBM FORCES</u>							
U.S./NATO:							
PII SYSTEM	X			X	X		

Figure 3.3: Strategic Impact of Selected New Technology Applications On the Soviet Union

POTENTIAL APPLICATIONS OF NEW TECHNOLOGY OF STRATEGIC IMPORTANCE TO THE SOVIET UNION MID-1980s - 1990s	DEGREE OF IMPORTANCE TO THE SOVIET UNION			SOVIET STRATEGIC FORCE OBJECTIVES AFFECTED			
	VERY HIGH	HIGH	MODERATE	COUNTERMILITARY MISSION	FORCE SURVIVABILITY	OPERATIONAL FLEXIBILITY	DAMAGE LIMITING
MRBM/IRBM FORCES (cont.)							
S.U.:							
RELOAD/REFIRE CAPABILITY		X				X	
NEAR-ZERO CEP AND/OR ERW FOR COLLATERAL EFFECTS REDUCTION			X			X	
DUAL CAPABLE OR CONVERTIBLE IRBM/ICBM			X			X	
AERODYNAMIC FORCES							
U.S./NATO:							
B-1 OR STRETCHED FB-111		X		X	X		X
WIDE-BODIED ALCM CARRIER		X			X		X
GLCM IN EUROPE	X			X	X		X
SLCM		X		X	X		X
SURFACE SHIP-BASED CMs			X	X	X		X
ZERO-CEP CMs		X			X		
VERY LOW OBSERVABLES (STEALTH technology for bombers/CMs)	X				X		X
IMPROVED ECM/ECCM			X		X		X
S.U.:							
NEW INTERCONTINENTAL BOMBER AND/OR ALCM CARRIER			X			X	
ANTI-SHIP SYSTEMS WITH LONG RANGE TARGET ACQUISITION	X			X			
IMPROVED RANGE/PAYLOAD CAPABILITIES FOR BOMBERS, CMs		X				X	
IMPROVED ECM/ECCM			X	X		X	

Figure 3.3: Strategic Impact of Selected New Technology Applications On the Soviet Union (cont.)

POTENTIAL APPLICATIONS OF NEW TECHNOLOGY OF STRATEGIC IMPORTANCE TO THE SOVIET UNION MID-1980s - 1990s	DEGREE OF IMPORTANCE TO THE SOVIET UNION			SOVIET STRATEGIC FORCE OBJECTIVES AFFECTED			
	VERY HIGH	HIGH	MODERATE	COUNTERMILITARY MISSION	FORCE SURVIVABILITY	OPERATIONAL FLEXIBILITY	DAMAGE LIMITING
<u>ASW FORCES</u>							
U.S./NATO:							
MOBILE AREA SURVEILLANCE		X			X		
S.U.:							
LONG-RANGE IMPROVED FIXED OR MOBILE SENSORS	X			X			X
SSN QUIETING		X			X		
SSBN TRAILING SYSTEMS		X		X			X
<u>BMD FORCES</u>							
U.S.:							
HARD-SITE ICBM DEFENSE	X			X			
AREA ABM DEFENSE		X		X		X	
S.U.:							
HARD-SITE ICBM DEFENSE		X			X		X
AREA ABM DEFENSE		X			X		X
<u>ASAT/SPACE WARFARE</u>							
U.S.:							
NON-NUCLEAR ASAT		X			X	X	
SHUTTLE-BASED SATELLITE INSPECTION		X				X	
ENHANCED SATELLITE SURVIVABILITY (HARDENING, MANEUVERING)			X	X			
ADVANCED/EXOTIC ASAT	X			X		X	
S.U.:							
GROUND-BASED LASER ASAT		X		X			
SPACE-BASED LASER OR PBW		X		X			

Figure 3.3: Strategic Impact of Selected New Technology Applications On the Soviet Union (cont.)

POTENTIAL APPLICATIONS OF NEW TECHNOLOGY OF STRATEGIC IMPORTANCE TO THE SOVIET UNION MID-1980s - 1990s	DEGREE OF IMPORTANCE TO THE SOVIET UNION			SOVIET STRATEGIC FORCE OBJECTIVES AFFECTED			
	VERY HIGH	HIGH	MODERATE	COUNTERMILITARY MISSION	FORCE SURVIVABILITY	OPERATIONAL FLEXIBILITY	DAMAGE LIMITING
<u>AIR DEFENSE FORCES</u>							
U.S.:							
FULL AWACS IN EUROPE, MID-EAST			X	X		X	
EXOTIC AIR DEFENSE			X	X		X	
S.U.:							
LOOK-DOWN/SHOOT-DOWN INTERCEPTORS	X				X		X
AWACS	X				X		X
LONG RANGE INTERCEPTORS		X			X		X
SAM CAPABLE OF CM INTERCEPT	X				X		X
<u>C^3I SUPPORT</u>							
U.S.:							
MORE SECURE, SURVIVABLE C^3 NETWORK			X	GENERALLY APPLICABLE TO ALL OBJECTIVES			
REAL-TIME, ALL-WEATHER SURVEILLANCE AND TARGETTING	X						
S.U.:							
IMPROVED BMEW AND ATTACK CHARACTERIZATION CAPABILITY		X		GENERALLY APPLICABLE TO ALL OBJECTIVES			
REAL-TIME, ALL-WEATHER SURVEILLANCE AND TARGETTING	X						
HIGH DATA-RATE BATTLE MANAGEMENT NETWORK		X					
MORE COMPREHENSIVE CONCEALMENT AND DECEPTION		X					

Figure 3.3: Strategic Impact of Selected New Technology Applications On the Soviet Union (cont.)

perceive in this area is in part susceptible to manipulation by the United States by means of threatening -- or demonstrating -- a degree of technological advantage which has at least a reasonable prospect of persisting into the future. In this situation, both the budgetary cost and the opportunity cost to the Soviets of seeking to terminate or amend the ABM Treaty limitations radically could become a major factor in any decision and raise the question whether to accept a competition with the United States on this ground or to channel the strategic competition into other directions.

The deployment of mobile ICBMs is also an issue of high strategic significance to the Soviets which presents them with difficult choices. The U.S. deployment of the MX missile in a survivable basing mode would represent a threat of great significance to the Soviet Union. The MX system would provide the United States with a survivable "silo-killer" with a wide degree of operational flexibility. This would, in turn, degrade Soviet confidence in their countermilitary capability and force survivability, thus decreasing their confidence in their ability to engage in a damage limiting strike. The high degree of Soviet interest already evidenced in land-mobile ballistic missiles as a means of increasing survivability and flexibility is at least partially explained by U.S. developments in this area. The technological momentum and relatively near-term deployment of the MX system are such that the Soviets are unlikely to suppose that they can use arms limitation to avert the MX threat entirely, particularly since they consistently failed to do so in the SALT II negotiations. However, they may think that they could still reduce the threat by proposing quantitative limits, provided that these could be made consistent with any Soviet plans for a mobile ICBM system.

Another area of concern to the Soviets is U.S. achievement in the area of ASW. The continued substantial U.S. advances in this area in the face of still relatively inferior Soviet systems must be perceived as a significant threat by the Soviets to their SSBNs and there-

fore to their goal of force survivability. Nevertheless, the expectation of Soviet advances in submarine quieting and the possibility of operations in relative sanctuary as a result of the range of Soviet SLBMs provide them with defensive options. And the prospect of eventual breakthroughs in Soviet ASW technologies offers the hope of a substantial improvement in their objective of improved countermilitary capabilities. While, therefore, they might be interested in exploring agreements which would limit the risk of a U.S. breakthrough in the area of mobile area surveillance techniques, uncertainties about verification of ASW limitations and the fear of U.S. technological dominance in this area may make the Soviets uncertain where their best interest lies.

Another area of strategic significance to the Soviets is that of ASAT and space warfare capabilities -- both offensive and defensive. Here again, the Soviet calculus of advantage and disadvantage in the light of their own strategic objectives is a complex one, involving as it must consideration of the degree to which the Soviets see themselves becoming dependent on space-based intelligence platforms for the achievement of their vital strategic missions against, in particular, U.S. mobile ICBMs and carrier battlegroups. Certainly, the achievement of a damage-limiting pre-emption against such systems could be highly dependent on near-real-time target acquisition capabilities. In a similar vein, the Soviets must be quite concerned about both the U.S. ASAT program and the capabilities of the space shuttle for this purpose. While this is not the place for a detailed examination of these issues, it does appear on the face of it as if the issue is by no means a clear one from the Soviet perspective and as if the United States has some important technological cards to play in an attempt to influence Soviet perceptions.

In the area of aerodynamic forces, it is apparent that there is a range of likely developments on the U.S. side which the Soviets would be likely to see as having a considerable negative impact on their strategic objectives if they are allowed to go uncountered. But past

performance suggests that the Soviets are likely in the first instance to seek technological and deployment responses which could offset these developments and maintain Soviet damage-limitation capabilities, including against third party threats. In the past, Soviet leaders have clearly made such a substantial commitment to air defense that it would be likely to require a major change in the strategic environment to induce them to accept substantial limitations on its improvement in the future. It is not obvious that either the qualitative change in the threat represented by stealth technology or the quantitative increase in the threat represented by the proliferation of ALCMs would, in Soviet eyes, constitute such a major change.

These future technology applications. and others, will be discussed in greater detail in Chapters 4 and 5. For present purposes, it is sufficient to note that the distinctive and strong strategic objectives set for themselves by the Soviets and the Soviet decision-making structure as described earlier, with the weight it gives to military and industrial representatives, do not mean that there are no areas in which arms limitation would seem a perfectly rational option, in the Soviet perspective, to handle an impending change in the U.S./Soviet strategic relationship. Moreover, it should be apparent that the calculations the Soviets must make in order to make judgments as to where their interests lie in some of these areas are by no means simple ones with obvious answers, but require trade-offs between different objectives no less complex and difficult than those which are quite familiar in the United States.

3.6 FOOTNOTES

1. Major General K. Bochkarev, "The Question of the Sociological Aspect of the Struggle Against the Forces of Aggression and War," Voyennaya mysl', Number 9, September 1968, pages 3-4.

2. Leon Goure, Foy D. Kohler, Mose L. Harvey, The Role of Nuclear Forces in Current Soviet Strategy, monograph in International Affairs, Center for Advanced International Studies, University of Miami, 1974, pages 103-104.

3. Marshal A. A. Grechko, Vooruzhennye sily Sovyetskogo gosudarstua (The Armed Forces of the Soviet State), Second Edition (Moscow, 1975), and in translation by the USAF in its series Soviet Military Thought, Number 12, page 75.

4. Bochkarev, Ibid, page 15.

5. G. A. Trofimenko, SSha: Politika, voina, ideologiya, pages 318-319, cited in R. Garthoff, "Mutual Deterrence, Parity, and Strategic Arms Limitation in Soviet Policy," unpublished.

6. Admiral S. G. Gorshkov: "Navies in War and Peace," summarized in Abram N. Shulsky: "Gorshkov on Naval Arms Limitations: Kto Kogo in Paul J. Murphy, ed., Naval Power in Soviet Policy: Studies in Communist Affairs, Vol. 2, U.S. Air Force, 1978.

7. Thomas W. Wolfe, The SALT Experience, Ballinger Publishing Co., Cambridge, Massachusetts, Chapter 3.

8. N. V. Ogarkov, "Military Strategy" in the Soviet Military Encyclopeida, Volume VII, sent to press September, 1979.

9. See especially John Sell, Soviet Major Weapons Systems Development Programs, 1950-2000, System Planing Corporation, Unpublished.

10. Major General V. I. Zemskov, "Wars of the Contemporary Era," Voyennaya Mysl, Number 5, May 1969, page 57.

11. Gerard Smith, Doubletalk, Doubleday and Company, Inc., (1980), page 107.

4.0 THE POTENTIAL STRATEGIC IMPACT OF DEVELOPING TECHNOLOGIES

4.1 INTRODUCTION

This section provides an assessment of developing military technologies in a structure designed to illuminate their likely strategic impact should their potential be carried to full technical and operational maturity. Insights into where military technology may lead can be sought from several different perspectives, such as the state of understanding of basic physical principles, the state of development of devices utilizing basic principles or the state of application to weapons systems. This assessment focuses on military systems which can have a substantial impact on the strategic future, and includes the technological, developmental, and cost factors which appear to make some potential systems highly significant and others less so. A weapons system framework rather than a pure technology framework was selected for two primary reasons: (1) the strategic future will be impacted by weapon system applications of several different technologies, not by single technological breakthroughs, and (2) arms limitation negotiations are much more likely to be concerned with limiting specific systems than with constraining development of individual technologies.

Under such an approach, care must of course be taken to insure that a technology which begets an entirely new systems concept is not overlooked. Thus the spectrum of developing technologies was carefully examined to insure that the "systems" approach did not obscure such revolutionary technologies. Although none were found, this is not to say that such technologies do not exist -- in fact historical experience indicates that they often do. Rather such technologies as were reviewed are today at such an early state of development that their future applications to military systems cannot be identified and if such applications emerge, it will likely be in a time period beyond that of this study (10-15 years ahead).

The results of the survey of emerging military systems and technologies are displayed in tables 4.1 to 4.5. Although the results are pre-

sented in an unclassified and general form, the survey covered available documents and incorporated contributions from informed individuals which were often classified and highly technical. The judgements reflected in the table entries were likewise derived by the authors from available classified and unclassified written materials on emerging technologies and from interviews and discussions with knowledgeable employees and consultants of Science Applications, Inc. Preceding the tables is a description of their structure and definitions of their various parts and the rating scales used for the entries. The tables are accompanied by a discussion of some of the more important systems and the explanation/rationale for some of the entries. A short concluding section summarizes those systems and technologies identified as being most significant in terms of strategic and procurement cost impacts.

4.2 STRUCTURING THE ASSESSMENT

4.2.1 The Systems and the Matrices

Ballistic missile defense systems, offensive nuclear strike systems, air defense systems, space warfare systems, and ASW Systems were identified from a larger initial set of categories which included ground force and other systems as being the categories of systems most important for the purposes of this study. A separate table is set up for each of these categories. Each category of systems is further broken down into specific application systems either of progressively more difficult levels of development or of qualitatively different approaches. These specific systems are then displayed in a matrix within which a variety of factors bearing on each system may be evaluated and in which the systems' development status and overall potential impact may be judged. For each system a rating scale provides judgements on:

- The projected level of R&D interest on the part of the United States and the Soviet Union in each postulated system.
- The problems involved in a variety of technical/military "controlling factors", ranging from whether the system is ripe even for concept definition to the likely difficulty of full development.

- The problems involved in exploiting relevant sub-system technologies.
- The overall cost of deploying the system in militarily significant numbers as measured against its development cost.
- An assessment of the overall strategic impact of successful development and deployment of the system.

Judgements are made in each case from both the U.S. perspective and the Soviet perspective. Where the two differ, both appear, with the U.S. rating on the left separated from the Soviet rating by a slash line, "/".

The following paragraphs describe the factors and the rating systems. It will be helpful for the purpose of understanding the approach to refer to one of the completed systems matrices while going through these explanations.

4.2.2 R&D Interest

The "R&D Interest" entries are based on assessments of historical interests of the two sides and the projection of current trends in these interests. For example, the Soviet Union has historically shown a much stronger interest than the United States in air defense systems, independent of its ability to defend against ballistic missile threats -- a situation which continues to exist. The rating scale is very high interest (VH), high interest (H), medium interest (M), and low interest (L). For cases in which the interest level is unknown, a question mark (?) is entered.

4.2.3 Controlling Factors

In order for emerging technologies to be brought together successfully to develop any new operational system, certain fundamental issues have to be addressed successfully. The "controlling factors" include:

- System Concept Definition: Difficulty of configuring a system to fulfill the role expressed in the name of the system (left column).

- Development and Implementation Cost: Cost of system development plus deployment in numbers sufficient for major strategic or tactical impact.

- Countermeasures/CCM Race: Difficulty of configuring the system so that it is not unduly vulnerable to countermeasures of moderate cost. "Difficulty" may also include a perception that countermeasures may result in the need to multiply the number of units in the system and hence exaggerate its cost (e.g., if AAW targets have small radar cross sections, the number of defense units required in a sector could be larger).

- Perception of problems in advancing the state-of-the-art in some technologies and tying together all the relevant technologies (a summation of the collective difficulty across the technologies).

The "Controlling Factors" entries in the matrix are ranked on a scale from 1 to 3, with 1 implying maximum difficulty or highest cost and 3 implying state-of-the-art design or modest cost.

4.2.4 Technologies

The list of technologies chosen for the matrix reflects the spectrum of broad technology fields which are most likely to be required for development and deployment of any military system. While the particular list chosen is not meant to be definitive or unique, it does provide a convenient mechanism for highlighting the impact of different technologies on different systems. For the "Technologies" entries, decreasing difficulty of development is expressed on a scale from A to C, as follows:

A. Major advances in the current state-of-the-art are required; some risk that initial objectives must be downgraded.

B. Major development of state-of-the-art is required, but good chance that it can be achieved if resources are made available.

C. State-of-the-art development, or at worst a minor advance on state-of-the-art.

4.2.5 Development Cost/Unit Cost

A "development cost/unit cost" entry provides a sense of the relationship between the total development cost reflected under "Controlling Factors" and the cost of individual deployed units when all costs are prorated. In the scaling of entries, 1 implies that development costs are high and will be spread over relatively few units; 3 implies that deployments will be large enough to keep individual unit costs relatively low.

4.2.6 Overall Strategic Impact

This entry is a net judgement of the effect of successful development and deployment of the system on the current U.S./Soviet deterrence/force posture relationship. The classification used in the overall impact entry is as follows:

I. A development the success of which would change the strategic relationship in a major way and would require qualitative change in the nature of strategic forces (e.g., BMD system that promises successful damage denial).

II. A development that promises a quantitative erosion of the strategic relationship and could stimulate an operational or technological response/counter-response cycle (e.g., limited ASAT systems).

III. Lesser developments of technologies and systems which in themselves should not change the strategic relationship significantly but, which may generate the perception that they are steps toward I or II.

4.3 SYSTEMS AND TECHNOLOGY ASSESSMENT

4.3.1.1 Table 4.1. Ballistic Missile Defense Systems

A wide variety of potential BMD systems were considered, ranging from straightforward defenses for hard installations using atmospheric interceptors such as SPRINT to wide area, virtually leak-proof defenses using large space platforms and exotic kill mechanisms.

Three factors dominate any calculation of the effectiveness of presently conceived BMD systems:

- o Is it leak-proof to a sufficient degree?
- o Can so many interceptors be deployed that in practical terms a tactic of exhausting the defense resources by deploying large numbers of MIRVs or precision decoys is infeasible?
- o Are all valuable targets defended, or are so many unprotected that some significant attack objectives might be met by targeting undefended elements?

Regarding classical BMD systems conceived to alleviate the t [illegible] at to military targets, particularly ICBMs, it is apparent that the develo [illegible] t of such systems would be relatively straightforward when the problem [illegible] o defend current ballistic missile silos. It becomes far more comple [illegible] challenging if the objective it to defend mobile missiles.

First, in the defense of hard targets, the requirement to be leak-proof is not overly severe. In the absence of a massive increase in strategic offensive weapons, the average number of RVs likely to be available against any one of a thousand ICBM sites is at most of the order of tens so that the interceptor reliability requirement is of the order of 95% rather than 99%. Moreover, shoot-look-shoot firing doctrines may be feasible for this purpose, since an intercept at a low altitude may still limit damage to a hard target. Secondly, because there is no attempt to save all targets, there is reduced concern with selective attacks where missiles are concentrated on a few targets. Thirdly, given the relatively lower costs of hard-site defense, the attacker may not have the option of concentrating on undefended sites.

But hard-site defense of a "shell-game" deployment raises complex problems if (a) it must be effective even if the offense has intelligence of where the missiles are concentrated, and (b) it is assumed that maneuvering re-entry vehicles (MaRVs) might be employed to hide the attack objective until late. For then it might be necessary to invoke a preferential defense tactic in order to counter all of the RVs that may be attacking the occupied site. Hence, terminal defense against MaRV cannot yet be considered a straightforward technology.

As for true area defenses, there are currently two concepts, neither of which, at present, appears to be feasible.

First, if a ground based system using classical interceptors could launch at target missiles more than a thousand miles away with reasonable probability of hitting them, a large area could be defended. The interceptors and detection and guidance radars for such systems are within the state-of-the-art. But for the foreseeable future the concept fails because it is easy to design and deploy decoys and chaff capable of confusing the launch and management functions for interceptors that must necessarily be launched while their targets are outside the atmosphere. Conceptual designs were made for such penetration aids in the 1960s. Balloon decoys, each weighing a fraction of a pound, appeared to be feasible, along with chaff dispensing packages capable of hiding RVs in a train hundreds of miles long. More recent speculation on the introduction of infra-red technologies into BMD suggests that future exoatmospheric penetration aids may have to be somewhat more substantial, but it must be assumed that they are feasible and probably straightforward.

Second, an alternative that may be approaching technical feasibility would be to base an "exotic" system in low satellite orbit to be effective against the vulnerable boost phase of a missile attack. The potentially available weapon is the high energy laser, with an effective range in the order of 1000 miles. But the cost of such a system would be high: possibly 150 satellites would be needed to maintain continuous coverage of launch points, and their cost might be as much as $2 billion each.* This cost would be multiplied if the system had to deal with boosters hardened against laser effects. Particle beam weapons provide a less developed alternative for the same role and, if the technologies prove out, hold promise of being cheaper than the laser weapons.

*Michael May mentions $1 or $2 billion as a conservative cost of a comparable laser ASAT station (California Arms Control Seminar, 11/11/80).

The development of space-based BMD requires the resolution of a range of difficult systems engineering problems. In addition to the laser or particle beam weapon itself, a pointing and tracking system accurate to the order of a microradian is needed (a requirement which is especially intractable for PB weapons), power supply problems are non-trivial, and the weapon management process must be reliable, fail-safe and invulnerable to countermeasures.

However, the feasibility of space-based BMD could be affected by further technical breakthroughs. For example, the Lawrence Livermore Laboratory has performed experiments on a compact nuclear weapon pumped X-ray laser technology, and while it is easy to point out that the system's problems will be exceedingly difficult to resolve, such innovations offer promise of helping to meet the demand of a functioning area BMD system in the distant future. It is also conceivable that ground based radiation weapons might provide a future area defense. A network of such weapons (be they particle beam, like the 1960s SEESAW concept, or microwave, like the COMET program of the same era) would have a theoretical area defense capability since the key limited resource -- electrical power -- can be switched to any target which is under attack at the expense of a reduced capability at targets which are not threatened. But such approaches are too far in the future to allow informed discussion and are not included in the tables.

4.3.1.2 Commentary on Critical Entries in Table 4.1

1 Atmospheric Intercept: Site Defense

The 1 entry under the systems concept definition refers to the currently unresolved problems that would occur given that a defense of a mobile ICBM must face maneuvering re-entry vehicles in a situation where the acquisition of intelligence information regarding the location of the missiles cannot be excluded. That same entry would be a 3 in the context of defending hardened missile silos. Development difficulty is rated 2 because

TABLE 4-1
BALLISTIC MISSILE DEFENSE SYSTEMS

		CONTROLLING FACTORS				TECHNOLOGIES								COST, IMPACT	
	R&D INTEREST	SYSTEM CONCEPT DEFINITION	DEVELOPMENT & IMPLEMENTATION COST	COUNTERMEASURES/ CCM RACE	DEVELOPMENT DIFFICULTY	SENSORS	INFORMATION MANAGEMENT	COMMUNICATIONS	VEHICLES/ PLATFORMS	GUIDANCE/ CONTROL	WEAPONS	SELF PROTECTION	HUMAN FACTORS, MANNING MAINTENANCE	DEVELOPMENT COST/ UNIT COST	OVERALL IMPACT IF SUCCESSFUL
1. Atmospheric intercept, site defense	M/?	1	3/2	2	2	C	B	C	C	C	C	C	C/B	3/2	III
2. Tactical ballistic missile defenses	M/H	3	3	2	3	C	B	C/B	C	C/B	C	C	C	3	II
3. Atmospheric intercept, city/ICBM field defense	M/H	2/3	1/2	2	2	C	B	C/B	C	C	C	C/B	C/B	2	II
4. Exo-atmospheric intercept, city/ICBM field	M/H	2	1/2	1	2	C	B	C/B	C	C	B	C/B	C/B	2	II
5. Area defense ground-based*, capable against exo-penaids	?/?	3	2	1	2	B	A	C/B	C	C	B	C	C/B	2/1	I
6. Area defense, space-based*	?/M	1/2	1	1	1	B	A	C/B	C	B/A	B	B	C	1	I

*Entries highly speculative since system concepts embryonic
(5) possibly mid-course intercept.
(6) conceivably space-based laser or PBW vs. boost phase.

of the problems of developing hardened radars and interceptors capable of dealing with terminal MaRVs.

2/3 Atmospheric Intercept: ATBM and City/ICBM Field Defense

ATBM and city defense systems defend soft targets. Both can be defeated by a combination of exo-atmospheric penetration aids and endo-decoys. The penetration aid threat is less severe for tactical missiles because there is only a short time for their deployment. But the development of both ATBM and city defense BMD implies severe anti-leakage requirements.

If technology overcomes these problems, serious questions would be raised about deterrence concepts based on assured destruction of cities. However, if likely resource limitations are assumed, it would be prohibitive to provide full protection for all cities in a situation in which the attacker would have the option of concentrating his considerable MIRV inventory against the highest priority targets. Hence a II, rather than a I, is assigned for overall impact.

4 Exo-Atmospheric Defense: City and ICBM Field

This entry refers primarily to the concept of an exo-atmospheric element for the defense of hardened targets in a "layered" defense system (LDS). If such an element can be successfully developed it would simply reduce the rate of arrival of RVs at the terminal element. It would not dispose of the preferential defense problem discussed under 1 above.

The "countermeasures race" is indicated as the chief controlling factor in this category. Recent experience suggests that no sooner is a solution to the RV discrimination problem proposed than a countermeasure becomes apparent (e.g., once LWIR was proposed to bypass the difficulties of radar discrimination of balloon decoys, heating of the decoys was postulated).

If a successful layered defense is developed, it would, of course, have the same strategic impact as any other city defense.

5 Area Defense, Ground-Based, Capable Against Exo-penaids*

The concept here is a more capable exo-atmospheric defense than system 4 but still using large interceptors and long-range radars. The idea is to stockpile interceptors at one or more central sites from which conventional interceptors could reach any RV no matter what its impact point. Discrimination and tracking would have to be early enough to allow designation to an interceptor 10-15 minutes before impact. The key to its feasibility is solution of the now-intractable problem of exo-atmospheric discrimination. Again, the countermeasures problem dominates.

A system such as this, which goes beyond simply raising the price of admission to provide absolute protection, could lead to an upset of the strategic balance, hence the I under Overall Impact.

6 Area Defenses, Space-Based

This is a concept for employing many low-to-medium altitude satellites with laser or PBW systems for attacking missiles in the boost phase. The concept is one of very high cost and difficulty (see above). As opposed to the preceding system (5), it bypasses the most severe discrimination problems by attacking the missile before separation and deployment of penaids. The remaining -- and considerable -- countermeasure problems are likely to be concerned with hardening, which would drive up the beam power requirements, the vulnerability of the space-based platform, and the degradation by inherent motion or weapons effects of the weapon aiming subsystem. Note that this type of BMD might be hard to distinguish from laser or PBW anti-air and anti-satellite systems (Tables 4.3 and 4.4.).

*While ship-based systems operating against the boost phase of an SLBM have been proposed in the past, they are not discussed here because they are unlikely to be economically or technically feasible in the time frame of the study.

As with 5, development of such a system would upset the current concepts of deterrence and require major changes in force posture.

4.3.2.1 Table 4.2. Offensive Nuclear Strike Systems

The offensive systems issues considered in this report are selected to address three developing technical thrusts:

- o Ballistic missiles having either a major counterforce potential or a capability to survive counterforce attacks.
- o Ballistic missiles having a high capability to negate any BMD that may be deployed.
- o Cruise missiles that reproduce many of the capabilities of ballistic missiles at an order-of-magnitude less cost.

All present offensive system concepts are based on technologies that are mature in the sense that further advances are unlikely to revolutionize today's strategic balance. MIRV is operational, and the only radical aspect of today's cruise missiles are 'stealth' technologies and the fact that they can be produced at a much lower cost than seemed possible one or two decades ago. Hence, the systems explored in this paper are incremental advances on established capabilities.

With regard to counterforce capabilities, the evolution of high precision guidance and compatible geodesy will within the next few years present the United States and the Soviet Union with technologies whereby a reliable missile can be detonated very close to any identified target. Then the cost in re-entry vehicles of destroying a target will be set by limitations in reliability and in target designation.

The second issue -- a capability against BMD -- requires evolutionary developments of penetration aid technologies that were the subject of intensive research in the 1960s. But the most conservative penetration guarantee is the deployment of very large numbers of re-entry vehicles, and such a capability is already in being with the widespread deployment of MIRV.

Finally, conceptual areas for improvement in cruise missile technology include pre-launch survivability, invulnerability to defenses and lethality. No new technology that alters pre-launch survivability is apparent. But while today's cruise missile designs have many attributes (e.g. low radar cross-section, operation at low altitude) which make them highly resistant to defenses, further advances in the offense/defense race can be envisaged, advances which may reduce the penetrability of cruise missiles or, at least increase their cost. Finally, the high accuracy of state-of-the-art cruise missiles does not represent the end of the road of the capability for destroying hard targets with medium yield weapons. Further improvements are contemplated in Table 4.2.

4.3.2.2 Commentary On Critical Entries In Table 4.2

1 Advanced IC/IR/MRBM with Very High Accuracy

In the United States the threat of ICBMs with very high accuracy has driven the difficult search for a survivable MX basing concept and has led to the implementation of road-mobile missiles in the Soviet Union. There remains a question as to the strategic impact of further developments in counterforce ICBM or SLBM accuracy and reliability. In particular, should it prove possible to utilize missiles with several tens of MIRVs, each with a reliable potential for destroying a given hardened target the situation of even a large defensive system could be expected. Accordingly, in Figure 4.2 a II is indicated for the overall strategic impact of Soviet development of advanced missiles of high accuracy.

2 Advanced IC/IRBM with High Penetrability vs. BMD

Item 2 is the obverse of the BMD issues of the preceding section. There is currently every reason to suppose that ICBM countermeasures to BMD can be successfully implemented to a level which will deny major advantage to

TABLE 4-2
OFFENSIVE NUCLEAR STRIKE SYSTEMS

		CONTROLLING FACTORS				TECHNOLOGIES									COST, IMPACT	
	R&D INTEREST	SYSTEM CONCEPT DEFINITION	DEVELOPMENT & IMPLEMENTATION COST	COUNTERMEASURES/ CCM RACE	DEVELOPMENT DIFFICULTY	SENSORS	INFORMATION MANAGEMENT	COMMUNICATIONS	VEHICLES/ PLATFORMS	GUIDANCE/ CONTROL	WEAPONS	SELF PROTECTION	HUMAN FACTORS, MANNING MAINTENANCE	DEVELOPMENT COST/ UNIT COST	OVERALL IMPACT IF SUCCESSFUL
1. Advanced IC/IR/SLBM, very high accuracy	H	3	3	3	2	?	–	–	B	B	C	–	–	3	III/II
2. Advanced ICBM/IRBM, high penetrability vs. BMD	H	3	2/3	3	3	–	–	–	C	B	C	–	–	2/3	II
3. Advanced ICBM/IRBM, mobile basing for high PLS	VH	2/3	1/2	2	2/2	–	C	–	C	B	C	–	?	2/3	II
4. Airbreathing vehicles for very high accuracy	H/M	3	2	3	2	B/?	B/?	–	C	B	C	?	C	3	III
5. Airbreathing vehicles for high AAW penetrability	H/M	2	2	2	2	C	B	–	B	B	B	B	C/B	3	III

the defense, albeit at significant cost. And, it still appears that the cost of counter-countermeasures to defeat them is prohibitive.

Such a response-counter-response cycle could create an enormous demand for resources, hence the II for overall impact.

3 <u>Advanced ICBM/ IRBM, Mobile Basing for High PLS</u>

MX in the United States and road mobile systems for the Soviet Union are developments which require no radically new technology. The concern is to identify systems which attain the necessary increase in survivability at acceptable cost. Again, the costs of developing and fielding such systems to deprive the other side of a counterforce capability leads to the II impact.

4 <u>Airbreathing Vehicles for Very High Accuracy</u>

This concept relates to an evolution of the current generation of ground-, air-, or sea-launched cruise missiles into vehicles capable of extremely precise attack. U.S. cruise missiles are currently guided by a combination of satellite and terrain matching (TERCOM) techniques to achieve accuracies of the order of 100 meters. Evolutionary improvements in terrain matching and other techniques, such as autonomous terminal homing (ATH), can provide even higher accuracies in numerous applications. But the low cost cruise missile already has major strategic implications with its current characteristics and the ramifications of improving nuclear weapon delivery accuracies beyond the present level appear to be marginal. An increase in accuracy may be most important in allowing the effective use of conventional warheads against tactical or even strategic targets.

5 <u>Airbreathing Vehicles for High AAW Penetrability</u>

This set of entries relates to cruise missiles or bombers capable of defeating air defenses. While the current low-flying, low-radar-cross-section cruise missile has a considerable capability against present day SAM

and interceptor defenses, it will become vulnerable if a "look-down shoot-down" defense integrated with AWACS-type sensors is deployed. The "high AAW penetrability capability" of chart 2.5, then, is by implication a future technology which protects against look-down shoot-down. One can speculate that the cruise missile might in the future be configured to deploy sub-missiles as a means for improving penetration in the same way as bomber penetration is enhanced by deploying cruise missiles and ICBM penetration is improved by MIRVs. A multiple sub-missile cruise system would almost certainly be much larger than the current U.S. cruise missiles. As opposed to MIRV, where a multiple RV payload is deployed with a substantial economy in boosters, a sub-missile cruise system would not appear to offer an advantage over an equivalent force of separate missiles, except in providing a somewhat less costly launcher element.

4.3.3.1 Table 4.3. Air Defense Systems

A requirement for defense against strategic bombers is a problem specific to the Soviet Union. Since in practice the Soviet strategic force is an ICBM/SLBM "dyad", there is not now a requirement for the United States to deploy nationwide air defenses on the scale practiced by the Soviets.

The United States is, however, concerned with the air defense of aircraft carriers, especially against the threat of submarine-launched and air-launched cruise missiles. Similarly, both the United States and the Soviet Union have made major expenditures for the air defense of field armies.

The air defense technology associated with national air defense (or any other application where a small leakage is acceptable) is largely based on evolutionary advances in the missile system concepts of the 1950s and on advanced radar concepts (phased arrays, AWACS) of the 1960s. Such air defenses operate as a large deployment of individual defense units and the costs of the entire system are very great. Obviously a technological

breakthrough that provides an equivalent capability with a much lower price-tag would have a high strategic impact, but no such breakthrough is in sight. Instead, the leading edge of air defense research points toward expensive particle beam and laser weapons which could destroy any attackers that survive the outer elements of a multi-layer air defense. Their self-evident role is in the defense of very high value targets, especially aircraft carriers.

4.3.3.2 Commentary on Critical Entries in Table 4.3

1 Advanced Nationwide Air Defense System, Including Look-down/Shoot-down

The primary vulnerabilities of the Soviet nationwide air defenses are to low altitude, low cross-section cruise missiles and to Stealth-type aircraft operating at low altitude in an electronic deception and jamming environment. A capability for airborne detection by AWACS-style equipment can reduce the low altitude vulnerability: the target missile or aircraft is no longer masked by terrain, and its radar return is likely to be increased.* A self-evident complement to airborne detection is a look-down shoot-down air intercept capability. Both detection and intercept systems would require substantial development effort for the Soviets, and very high costs. If achieved, however, these could bring into question the continued viability of U.S. airbreathing vehicles for long range nuclear strike.

2 Advanced Battlefield or Key Installation Air Defense

These systems continue to evolve, but without major technological or strategic impact.

*Very small radar cross-section is frequently associated with near nose-on aspects of the target, say within ± 60 degrees. These are the aspects associated with detection by SAM systems. But airborne systems can perform operationally useful detection at side, rear, and down-looking aspects where the cross-section is much increased.

TABLE 4–3
AIR/CRUISE MISSILE DEFENSE SYSTEMS

		CONTROLLING FACTORS				TECHNOLOGIES								COST, IMPACT	
	R&D INTEREST	SYSTEM CONCEPT DEFINITION	DEVELOPMENT & IMPLEMENTATION COST	COUNTERMEASURES/ CCM RACE	DEVELOPMENT DIFFICULTY	SENSORS	INFORMATION MANAGEMENT	COMMUNICATIONS	VEHICLES/ PLATFORMS	GUIDANCE/ CONTROL	WEAPONS	SELF PROTECTION	HUMAN FACTORS, MANNING MAINTENANCE	DEVELOPMENT COST/ UNIT COST	OVERALL IMPACT IF SUCCESSFUL
1. Advanced nationwide system, including look-down/shootdown	M/VH	3	1	2/1	2	B	B/A	C/B	C/B	C/B	C/B	C	C/B	2	III/II
2. Advanced battlefield or key installation defense	M/H	2	2/2	2	2	B	B/A	C/B	C/B	C/B	B	C	B	2	III
3. Advanced fleet air defense systems	H/?	2	2	2	2	B	B	C	B	B	B	C	B	2	II/III
4. Exotic kill mechanisms for 1, 2 and 3	H	2	1	1	1	C	B	C	A	A	A	C	B	1	II

3 Advanced Fleet Air Defense Systems

Effective and leak-proof air defenses are necessary if major units of a fleet (especially U.S. aircraft carriers) are to survive, even an intensive conventional attack. This development would involve substantial expenditures. In the United States, the use of "exotic" particle beam air defenses are under examination (see below) as a "last ditch" system of in-depth air defenses where the outermost layers employ air intercept and the intermediate defense is based on surface-to-air missiles. Attainment of an effective air defense against conventional and nuclear attacks is extremely important to the United States, but less so to the Soviets, who are less dependent on naval surface units in their military strategy.

4 "Exotic" Kill Mechanisms for 1, 2 and 3

The cruise missile threat to U.S. carriers, where a low flying missile may be detected too late for conventional intercept, has stimulated research on "zero-time-of-flight" charged particle beam and laser systems for shipboard applications. This might also develop into a system that is effectively proof against leakage, since many "shoot-look-shoot" firings would be possible.

Wide area air defense against long range bombers, transport, and control aircraft when at fairly high altitudes may eventually prove feasible from space stations employing laser or particle beam weapons. Any such systems developed for BMD would likely also be effective against all but terrain hugging aircraft. An effective nationwide air defense could threaten the viability of the one element of the U.S. Triad, hence the II for Strategic Impact.

4.3.4.1 Table 4.4. Space Warfare Systems

Anti-satellite systems (ASAT) in general threaten reconnaissance, C^3, and intelligence collection. They could also threaten weapons in space, if such systems are deployed in the future. Several potential types of ASAT are considered here. But they are not necessarily 'strategic' systems: it is inevitable that some satellites will be viewed in the same way as airborne reconnaissance and C^3I -- they are fair game in tactical warfare. However, there are technical stratifications which can be made between the several classes of satellite systems. For example, reconnaissance satellites mostly employ low, and hence more vulnerable, orbits; C^2 and navigation satellites -- both tactical and strategic -- are at high altitudes (approximately 22,000 miles) and harder to reach. Even so, one cannot conclude that such differences could provide a foundation for segregating ASAT into tactical and strategic classes because, while the launching rocket to lift a given ASAT to 22,000 miles is substantially larger than one needed to take the ASAT to a 150 mile orbit, its development and use presents no severe technical or cost problems. A more realistic segregation may be to distinguish between the limited capabilities of the first generation ASAT weapons and the vastly greater potential of the laser or particle beam weapons that might be fielded more than a decade hence. The former have worse than a one-on-one kill capability, while, in the absence of countermeasures, a small group of laser platforms might eliminate the majority of the opposition's satellites within a few days.

Nuclear weapons are not an inherent component of ASAT systems; only one of the seven systems outlined below employs nuclear kill.

4.3.4.2 Commentary on Critical Entries in Table 4.4

1 ASAT Missiles, Ground- or Air-Launched

The primary role of first generation ASAT missiles is against ocean surveillance, battlefield, and low-flying strategic reconnaissance satellites. Such missiles have at best a capability for a single HE impact kill.

TABLE 4–4
SPACE WARFARE SYSTEMS

		CONTROLLING FACTORS				TECHNOLOGIES								COST, IMPACT	
	R&D INTEREST	SYSTEM CONCEPT DEFINITION	DEVELOPMENT & IMPLEMENTATION COST	COUNTERMEASURES/ CCM RACE	DEVELOPMENT DIFFICULTY	SENSORS	INFORMATION MANAGEMENT	COMMUNICATIONS	VEHICLES/ PLATFORMS	GUIDANCE/ CONTROL	WEAPONS	SELF PROTECTION	HUMAN FACTORS, MANNING MAINTENANCE	DEVELOPMENT COST/ UNIT COST	OVERALL IMPACT IF SUCCESSFUL
1. ASAT missiles, ground or air launched	H	3	3	3	3	C	C	C	C	C	C/B	C	C	3	II
2. ASAT space mines	H/?	3	3	2	3	C	C	C	C	C/B	C	B	–	3	II
3. ASAT, disabling by EW	?	2	2	2	2	B	B	C	C	C	–	B	–	3	II
4. ASAT, space-based laser	H	2	1	1	1	C	B	C	C	B	B	B	C	1	I
5. ASAT, space-based PBW	?	2	1	1	1	C	B	C	C	A	A	B	C	2	I
6. Ground/air-based laser vs low-orbit satellites	M/H	2/3	2	2	2	C	C	C	C	C	B	–	B	2/3	III
7. ASAT, nulcear kill	?	3	2/3	2	3	C	C	C	C	C	B	C	–	3	?

But given the importance of satellites to military operations on both sides and the costs of their defense in terms of redundancy and hardening, deployment of even a primitive ASAT could have significant strategic impact, hence the II rating.

2 ASAT Space Mines

Space mines are defined as high explosive or impact kill weapons placed in orbit and activated on command prior to intercepting a satellite. In principle, such a system could achieve the difficult objective of intercepting a high altitude communications or navigation satellite far more readily than could a ground or air launched ASAT missile. Like system 1, the strategic impact of such a system is rated II.

3 ASAT, Disabling by Electronic Warfare

Communications satellites ground stations have a high resistance to jamming by ground- or aircraft-based emitters because such jamming can only enter the side lobes of the receiving antenna. The possibility that jamming into the main lobe could be implemented from a co-orbiting satellite placed near (e.g., within 100 miles of) the communications satellite is intriguing. If the latter were unresponsive to jamming, simple noise jamming at somewhat less than the satellite power would suffice to deny all communications. If the target satellite adapted to the jamming by concentrating its communications energy on a narrow band, adaptive tracking of that band should allow a sophisticated system to jam any signal at the same order of power. Evidently an EW satellite might not be emplaced in peacetime without challenge: current protocol is to space synchronous satellites by at least two degrees -- or more than an earth-station beam width. But it might be placed in an approximate orbit and maneuvered to its operational station only after the outbreak of hostilities.

4 Laser/Particle Beam Weapons and Anti-Satellite Systems

While the lethal range of a laser or particle beam weapon is insufficient to allow the immediate destruction of all satellites within its line of sight, the range could be of the order of 1000 km. Elementary system studies suggest that an ASAT having significant fuel could allow these multi-shot kill mechanisms to destroy a large number of satellites in a time of the order of days. Note that this is a technology analogous to that proposed for space-based BMD (Table 4.1) and indeed a space-based BMD laser system could be designed to have an ASAT role as well.

5 Ground/air-based Laser vs Low Orbit Satellites

Here the concept is to place high-powered lasers above the weather in an environment where atmospheric losses are small, i.e., either on mountain tops or in aircraft. As with system 1, this concept can only be effective against low-orbit satellites.

6 ASAT, Nuclear-Kill

A nuclear weapon detonated in orbit can disable the soft electronic systems of distant satellites as well as producing electromagnetic pulse effects on ground-based electronic systems. A nation that contemplates a nuclear ASAT may be deterred by consideration of the effects on its own satellites. (The complex electronic components of U.S. systems are reported to be more vulnerable than their Soviet counterparts.) A definitive systems vulnerability study would be necessary to determine whether their employment would be to the advantage of either side.

4.3.5.1 Table 4.5. Ocean Surveillance and ASW Systems

The basis of anti-submarine warfare is the detection, tracking and classification of the usually minute "signatures" generated by the passage of a vessel which hides in a vast and disturbed medium. Those signatures may be

acoustic, magnetic, hydrodynamic, or biological. But since its beginnings in World War I, ASW has relied mostly upon either the detection of a submarine's acoustic emissions or upon active acoustic sonar. During the past twenty years, since the extreme silencing of U.S. submarines was first implemented in the Thresher Class, the development of more sensitive acoustics has accelerated. Both the United States and the Soviets have maintained extensive programs in ocean research, having as their objectives the elucidation of other ASW-capable phenomenology. The technical and phenomenological constraints necessarily imply that, in spite of the difference in objectives, there is an overlap between the tactical ASW technologies and those for detection of ballistic missile submarines (SSBNs). Tactical ASW is largely concerned with the seeking out of submarines in limited theaters of action or in the vicinity of navies or convoys, where the submarine's tactic is to engage the enemy. Strategic ASW is directed against SSBNs, which have a primary objective of surviving, and hence of avoiding naval action.

At this time, passive listening using large arrays of hydrophones and advanced signal processing is the primary method of surveillance of ocean basins and choke points, while the use of active sonar (where the echoes of a transmitter pulse are reflected off the submarine hull) is for the most part limited to a role in the prosecution of contacts. In fact, once a submarine is detected and classified, a considerable group of passive and active systems, as well as airborne magnetic anomaly detection, may be brought to bear.

While sound and magnetism are the most straightforward manifestations of the presence of a submarine, other possibilities can be listed. They include the hydrodynamic disturbances in the wake, disturbances of bioluminescent marine organisms, nuclear emissions, and even the possibility of direct or LIDAR* visual detection. All have been the subject of substantial research; for the present, none appears as a leading candidate for maintaining extended ocean surveillance or any other major ASW capability.

*LIDAR: Radar at optical wavelengths. There is a "window" in the transmission of (green) light in sea water at a wavelength a little under 0.5 micrometers.

Two asymmetries -- one geographic, the other technical -- tip the ASW balance in favor of the United States. The first is that passive acoustic surveillance of the major ocean basins can be conducted with great economy by a nation having access to ocean bottom sites on the slope between the continental shelf and the deep ocean floor (or at similar depths on the slopes of volcanic islands). The United States has exploited its access to such sites to develop the world-wide SOSUS surveillance system; the Soviets have far fewer suitable locations available. The second factor is the U.S. technological advantage in submarine quieting. At the slow speeds suitable for SSBN operation, the radiated sound from U.S. submarines tends to be below the level of ambient shipping and wave-generated noise in the ocean basins.

4.3.5.2 Commentary on Critical Entries in Table 4.5

1 Fixed ASW Barriers

These are barrier systems of acoustic sensors, each element of which might detect submarines at ranges of the order of ten miles. Hence, a line of hundreds of sensor elements could span such vital regions as the Greenland-Iceland-U.K. gaps and prevent undetected movement through choke points. These systems are feasible now, based on SOSUS technology, but are extremely vulnerable and subject to quieting countermeasures.

2 Fixed Area Surveillance, Passive

The "deep sound channel" can sustain the propagation of sound over very long ranges in oceans having depths of the order of 10,000 feet or more. The United States has deployed the SOSUS system of a large number of hydrophone arrays at depths consistent with receiving the machinery and water flow noises that are radiated into this channel from distant submarines. At the time the system was initiated, SOSUS targets were the noisy first generation generation of nuclear submarines. In subsequent decades, submarines have become

TABLE 4–5
ANTISUBMARINE WARFARE SYSTEMS

		CONTROLLING FACTORS				TECHNOLOGIES								COST, IMPACT	
	R&D INTEREST	SYSTEM CONCEPT DEFINITION	DEVELOPMENT & IMPLEMENTATION COST	COUNTERMEASURES/ CCM RACE	DEVELOPMENT DIFFICULTY	SENSORS	INFORMATION MANAGEMENT	COMMUNICATIONS	VEHICLES/ PLATFORMS	GUIDANCE/ CONTROL	WEAPONS	SELF PROTECTION	HUMAN FACTORS, MANNING MAINTENANCE	DEVELOPMENT COST/ UNIT COST	OVERALL IMPACT IF SUCCESSFUL
1. Fixed ASW Barriers	H	3	2	2	2*	C	C	C	C	–	C	C	–	3	III
2. Fixed area surveillance —passive	H/L	3	2	1	3	C	B	C	C	–	–	B	–	3	II/III
3. Mobile area surveillance arrays	H/?	3/2	2	1	2	C/A	B/A	C	C	–	–	B	B	2	II/I
4. Fixed area surveillance — active	M/?	2+	1	1	2	B	B	C	C	–	–	B	B	2	I
5. Airborne surveillance & ASW weapons systems	H	3	2/1	1	2	B	B	B	C	–	C	B	C	2	II/I
6. Satellite detection systems	M/?	3	2	1	3	C	B	C	C	–	–	C	–	2	II
7. SSBN trailing systems	H	3	2	1	2	B	B	B	C	–	C	B	C	2	II/I

quieter. But signal processing of their radiations has advanced and the number of arrays has been increased -- apparently to the point where submarine silencing has been offset by improvements in the SOSUS system. Whether this stand-off can continue into the future is unclear. It depends on the evolution of Soviet submarine quieting as well as on the continuation of advances in signal processing. Hence the 1 under countermeasures.

3 Mobile Area Surveillance Arrays

SOSUS-like arrays can be towed behind ships to provide ASW surveillance in regions where no natural array sites are available, as well as to replace the coverage of faulty or damaged SOSUS. The U.S. development to this end is SURTASS. Again the big problem with such a system is the relative ease of countermeasures.

4 Fixed Area Surveillance, Active

If submarine silencing should bring about a future loss of the undersea surveillance capability off the U.S. coast, this could have major consequences for the U.S. strategic posture, since the SSBN threat to both bomber airfields and urban targets would be heightened. The Soviets may already be facing a parallel challenge as a result of the existing quiet operations of U.S. submarines. In all likelihood, the substitution of active sonar offers a technically credible solution to the long range area surveillance problem, since an early ad hoc modification of submarines to reduce their echoing properties is likely to be impracticable. Hence, the target-strength-reduction countermeasure (which is analogous to quieting against passive surveillance) might not be effective until a new generation of submarines of radically different design was constructed. The U.S. conducted experiments on active surveillance in the 1960s (Project ARTEMIS), using a very large sound generator suspended from a ship and a receiving array of hundreds of hydrophones deployed offshore from Bermuda. An alternative system might have used existing SOSUS as the sound receiver, along with an enormously powerful low frequency sound transmitter. The concept presents many technical problems, but none that appears insuperable given very high R&D

and implementation expenditures. They include the development of a radically new sound source, and a resolution of a number of difficult signal processing problems concerned with the classification of targets and their extraction from the background of reverberation from the ocean surface and bottom. The operation of this concept would not be covert, as with SOSUS, the source would be physically vulnerable, and the receiver susceptible to deception and jamming. But, if perfected, such a system could change the nature of undersea warfare and make U.S. SSBNs vulnerable. Hence the I in significance.

5 Airborne Surveillance and ASW Weapons Systems

Aircraft-deployed sound receivers (Sonobuoys) can substitute for fixed arrays, if the deployment is in a grid above the ocean bottom. In theory, by decreasing the distance between sound receivers, quiet submarines are detectable, if a high cost can be tolerated. The read-out would be by radio transmission from a sea-surface antenna direct to a patrolling aircraft. A significant factor is that such systems can be rapidly deployed, possibly in areas which have heretofore been regarded as safe areas for submarines.

6 Satellite Detection Systems

Proposals have been made to equip satellites with optical sensors capable of direct viewing of submarines at shallow depth. It has even been postulated that space-borne green-light LIDAR could have operational ability. Nevertheless, in either case, there seems to be little possibility that such techniques could operate to beyond the shallowest of the useful operating depths of submarines. Thus, while such systems might pose a threat to some tactical operations, they need hardly threaten SSBN security. If necessary, strategic submarines could without difficulty operate at medium depths and move nearer to the surface for navigational fixes under cloud cover. Radar or radio-frequency radiometers might find a place on ASW satellites, but the physical mechanisms by which they could operate usefully are obscure and probably non-existent.

7 SSBN Trailing Systems

It is hard to conceive how the survivability of either the U.S. or Soviet SSBN force can be compromised in a major way by another submarine's attempt at trailing, although the possibility of an occasional successful trail exists. Passive trailing is detectable and must be countered by supporting naval operations (or conceivably by technical countermeasures). In any case, a trailing capability involves operational procedures rather than special technologies.

4.4 CONCLUSION

Twenty-two of the systems reviewed in Tables 4.1 - 4.5 were judged to meet the criteria for a I or II ranking for overall strategic impact, a I for development and implementation cost, or both. That is, twenty-two systems appear to have the potential, if brought through development and deployment, of creating a major impact on the future strategic relationship or a major impact on future procurement needs. These systems are summarized in Table 4.6, which also reflects the major difficulties in system development (Is) and technology advancement (As) for each of these systems. The large number of critical systems relative to the total set examined is not surprising in view of the fact that the original set was structured to include those systems and related technologies which were expected to show a significant strategic impact.

The critical systems include both site and wide area BMD: site defenses because of the enormous costs involved in fielding the systems and in the countermeasures race such a deployment would provoke; and area defenses because they would require a change in current deterrence concepts. Several technologies are important to effective wide area BMD, the most difficult being management of information in the face of widespread employment of chaff, decoys and EW; and, in the case of space-based weapons, pointing and tracking for a narrow beam at long distances from a platform which is also generating the power to create the beam.

Offensive missile strike system improvements are judged to be critical primarily because of the cost of countermeasures which improvements

TABLE 4-6. SUMMARY — HIGH IMPACT SYSTEMS

		CONTROLLING FACTORS				TECHNOLOGIES								COST IMPACT	
	R&D INTEREST	SYSTEM CONCEPT DEFINITION	DEVELOPMENT & IMPLEMENTATION COST	COUNTERMEASURES/ CCM RACE	DEVELOPMENT DIFFICULTY	SENSORS	INFORMATION MANAGEMENT	COMMUNICATIONS	VEHICLES/ PLATFORMS	GUIDANCE/ CONTROL	WEAPONS	SELF PROTECTION	HUMAN FACTORS, MANNING MAINTENANCE	DEVELOPMENT COST/ UNIT COST	OVERALL IMPACT IF SUCCESSFUL
1.2 Tactical Ballistic Missile Defenses															II
1.3 BMD, Atmospheric intercept, city/ICBM field defense			1/2												II
1.4 BMD, Exo-atmospheric intercept, city/ICBM field defense			1/2	1											II
1.5 BMD, Area defense ground-based, capable against exo-penaids				1			A							2/1	I
1.6 BMD, Area defense, space-based		1/2	1	1	1		A			B/A				1	I
2.1 Advanced IC/IR/SLBM, very high accuracy															III/II
2.2 Advanced ICBM/IRBM, high penetrability vs. BMD															II
2.3 Advanced ICBM/IRBM, mobile basing for high PLS	VH		1/2												II
3.1 Advanced nationwide air defense systems, including look-down/shoot-down	VH		1	2/1											III/II
3.3 Advanced fleet air defense systems															II/III
3.4 Exotic air defense kill mechanisms			1	1	1				A	A	A			1	II
4.1 ASAT missiles, ground or air launched															II
4.2 ASAT space mines															II
4.3 ASAT, disabling by EW															II
4.4 ASAT, space-based laser			1	1	1									1	I
4.5 ASAT, space-based PBW			1	1	1					A	A				I
5.2 ASW, fixed area surveillance — passive				1											II/III
5.3 ASW, mobile area surveillance arrays				1			B/A								II/I
5.4 ASW, fixed area surveillance — active			1	1											I
5.5 ASW, airborne surveillance & ASW weapons systems			2/1	1											II/I
5.6 ASW, satellite detection systems				1											II
5.7 ASW, SSBN trailing systems				1											II/I

in accuracy and survivability would require. There appear to be no technological impediments either to the achievement of system improvements or to fielding effective countermeasures to those improvements.

Similarly, advanced air defenses do not offer the potential for upsetting the current strategic deterrence regime. But deployed in sufficient numbers, they would be extremely expensive and call forth a countermeasure effort which might change the configuration and role of strategic aircraft. Directed energy weapons for large area air defenses will be extremely difficult to develop and extremely expensive to deploy, but appear now to be technologically feasible.

Because of the extreme importance of space satellites to the military capabilities of both sides, all ASAT systems are judged to have considerable strategic significance. Systems which can effectively attack satellites in low orbit appear to be technically feasible now, requiring no major additional developments. But these systems, even proliferated, are unlikely to be able to neutralize all important enemy satellites. So their primary strategic significance would be that of triggering an expensive countermeasures cycle. Directed energy weapons from space platforms, however, if successfully developed, have the potential for destroying all satellites within a few hours or days. This capability would force a major change in the strategic environment.

Anti-submarine warfare developments which hold promise of reducing the survivability of ballistic missile submarines would be extremely important. All such developments would be likely to spawn extremely expensive countermeasures efforts in both countries in an attempt to maintain the invulnerability of the sea-based strategic deterrent. Wide area acoustic surveillance systems capable of handling vast amounts of information are the key to breaching submarine survivability. Such systems are technically feasible now. However, the Soviet Union lags the United States considerably in developing the necessary information processing systems.

An important relationship observable in Table 4.6 is that, of those few systems judged to have the potential for requiring a change in the nature of strategic forces (a I in the Overall Impact column), about half involve space-based, directed energy weapons. Not observable in the table is the fact that essentially the same weapon system in space can be designed for multiple-kill ASAT, wide area BMD, and even for wide area air defenses. The major differences among these applications are orbit height and the number of stations required, ranging from only a handful for effective ASAT to a hundred or more for BMD.

The development difficulty and costs for such systems are formidable both for the United States and the Soviet Union. But the technology, at least for space laser systems, now appears to be manageable, given sufficient application of resources. Further, the United States and the Soviet Union appear to be roughly equal in their mastery of the technologies required for such systems, with the United States ahead in some respects, such as information management and guidance/control, while the Soviet Union may be ahead in others, such as beam power generation. Neither country has successfully built and tested such a system. But both may be close to the capability for undertaking such a project.

5.0 THE ARMS LIMITATION ARMOURY

5.1 INTRODUCTION

In the analysis which follows, the above discussion will be integrated into an overall assessment of the prospects for an arms limitation contribution to specific defense problems. In this assessment, particular attention will be given, where appropriate, to the relevance of the hypotheses advanced in Chapter 2. This implies asking questions such as: Does a technological asymmetry exist? Is there substantial momentum in the development or application of the technology (i.e., in the language of Chapter 2, is one side or the other close to, and progressing rapidly toward, deploying an operationally effective system?)? Is the technology or the system amenable to diverse applications?

Other "lessons learned" from arms limitation negotiations to date will also be folded into the analysis. Some of these share territory with the hypotheses cited above, but still deserve mention in their own right. They include the following:

- Neither side should count on being able to use arms limitation negotiations as a means of gaining significant military advantage over the other. Rather, arms limitation opportunities are most likely to exist where a particular limitation is to the mutual advantage of both sides or where a particular limitation contributes to the solution of a problem unique to one side and can be balanced by a comparable limitation which contributes to the solution of a problem unique to the other. While the first category is far the easier to identify and prosecute, the second should not be ignored, since the disparity in force composition and technological development on the two sides makes this second category a potentially fruitful source of mutually acceptable and beneficial arms limitation packages.

- It is most unlikely to be possible in the time frame under consideration in this study to make revolutionary changes in the technical means of verification or the level of intrusiveness -- although some change in both these realms can be expected. Thus the assessment will focus on limitations designed to be adequately verifiable at either: (1) the

level of "intrusiveness" sanctioned in the SALT I and proposed SALT II agreements or (2) the next step of intrusiveness which might be negotiated as part of a future arms control agreement (e.g., on-site black boxes at test sites, controlled overflight by aircraft, limited on-site inspection as part of a sampling scheme, ban on telemetry encryption, etc.).

A more difficult problem concerns the issue of U.S. strategic objectives. As is well known (and discussed in Chapter 2), there has been considerable controversy regarding U.S. strategic objectives and the tightness of their application to arms limitation and defense procurement policies in recent years. In the light of this situation and in recognition of the likelihood that virtually any significant arms limitation negotiation, from conception to ratification, will span at least one and possibly several changes in administration, an effort was made to identify those strategic objectives which to date have been common to all administrations and virtually all points of view. Three were found which have generally been accepted as necessary, if not sufficient, objectives:

- Assured Second Strike Capability. Deter Soviet attack by maintaining forces which could sustain a massive Soviet attack and survive with sufficient capability to inflict damage in a retaliatory attack which would be viewed as unacceptable by Soviet leaders.

- Essential Equivalence. Ensure that the United States and its allies, and others whose security is important to the United States, can act without intimidation stemming from perceptions that the strategic relationship favored the Soviet Union.

- Escalation Control. Should deterrence fail and nuclear conflict occur, control escalation, limit damage to the degree possible, and terminate the conflict quickly on acceptable terms.

A fourth objective, "win the war should it occur" or, more accurately, "try to obtain the best possible outcome for the U.S. and its allies should escalation control fail and a nuclear war occur", is

also common to virtually all points of view. However, there remains disagreement as to the priority which should be given to systems whose principal utility is "war-fighting". This relegates to the realm of controversy such objectives as matching hard-target kill and damage limiting capabilities.

As was stated in Chapter 2, the task of analysis is to determine whether different arms limitation approaches are advantageous or not in the light of a given set of strategic objectives. The analysis which follows will not enter into arguments about different strategic objectives. It is therefore important to emphasize at the outset that behind both arms limitation policy and defense procurement policy lies the higher authority of overall strategic policy -- and that this is a realm of no small amount of controversy.

The discussion which follows will track the presentation of Tables 4.1 to 4.5.

5.2 BMD SYSTEMS (TABLE 4.1)

5.2.1 Atmospheric Intercept: Site Defense

At present, there is substantial technological momentum in the United States in site defense technology. This has grown in momentum response to concern that several of the most attractive deployment schemes for the MX may require BMD in order to insure the survivability of a large fraction of the MX force, especially in the absence of restrictive limits on ICBM fractionation and MIRVed ICBM launcher numbers such as those in the proposed SALT II Treaty. The Soviet Union would appear to lag the United States in this area, but it seems clear that current U.S. hard-site defense technology is not far beyond the reach of the Soviets. Thus the technological asymmetry would not seem to be severe at present. It remains to be seen whether the current momentum in hard-site defense technology can be translated into

a workable system, since a number of formidable technical problems remain to be overcome.

As noted in Chapter 2, there is little applications diversity in BMD generally. While this is changing somewhat with the nascent interest in ATBM, space systems and BMD for ships, it is clear that hard-site defense remains without applications diversity.

The strategic rationale for site defense as a means for enhancing the survivability of retaliatory forces is a strong one. On the other hand, permitting site defense cannot be viewed in isolation, but must be set in context --that context being the existing ABM Treaty with its tight limits on site defense and all other types of ABM systems. If relaxing the ABM Treaty limits to permit site defense meant abandonment of the Treaty or serious concerns about collateral capability to defend urban/industrial centers or other military targets, the strategic objective of assured penetration for deterrent forces would come into play. In such a situation, a highly challenging net assessment of the advantages and disadvantages to the United States of different possible regimes would be required. Such an assessment would involve answering questions such as:

1. Has BMD technology progressed to the point where an atmospheric intercept site defense system, effective against the projected ballistic missile threat, appears feasible?

2. Would the system still appear feasible if a responsive offense exploited the countermeasures (e.g. maneuvering RVs) that are probably technically feasible?

3. If the answers to #1 and #2 are yes, would such a system, when deployed by either the United States or the Soviet Union, be devoid of any significant urban defense capability?

4. Can qualitative and quantitative limitations be defined and verified that would insure that an endoatmospheric site defense system is devoid of significant urban defense capability?

If the answer to these four questions is yes, then there would be a strong rationale for seeking changes to the ABM Treaty to permit atmospheric intercept site defense BMD systems. If the answer to the first question is no, it is appropriate to ask: Would relaxing the qualitative limitations in the ABM Treaty (such as the ban on mobile BMD systems) create an environment in which an endoatmospheric intercept site defense system might be feasible? If the answer to this question is yes, then there would again be a strong rationale for considering a relaxation in the qualitative restrictions of the ABM Treaty to permit exploitation of this alternative.

For the foreseeable future, it appears that endoatmospheric site defense systems will consist of the standard components of interceptor missiles, their launchers and radars. As discussed below, each of these components can be limited numerically and qualitatively:

- Interceptor Missiles: In principle, interceptor missiles can be limited numerically in terms of numbers produced and numbers deployed/colocated with launchers. Limitations on numbers produced would only be possible with highly intrusive measures such as on-site monitoring at production facilities. Limitation on numbers deployed/colocated also raises difficult verification problems (although such limits are included in the ABM Treaty). If relatively small monitoring uncertainties (e.g. less than 25-50%) in this number were deemed necessary, on site inspection of BMD facilities would be required. Qualitative limits on atmospheric defense interceptor missiles designed to restrict their capability could include gross weight and burn time. Both of these parameters could probably be verified with telemetry obtained from satellite collectors.

- Launchers: Monitoring of numerical limits on BMD launchers can be accomplished with high confidence for fixed launchers. Such limits are included in the ABM Treaty. Numerical limits on mobile BMD launchers raise difficult verification problems -- akin to those for mobile ICBMs. However, as shown by the verification work done for the MX system, these problems can be solved, albeit at modest increase in cost. The only qualitative limit on launchers that is probably feasible

relates to mobility. While some systems are of a "transportable" character, it appears that a ban on mobile ABM systems such as contained in the current ABM Treaty can be monitored with high confidence.

- Radars: Because radars will continue to be of large size for the foreseeable future, numerical limits on fixed radars should be readily verifiable. On the other hand, numerical limits on mobile radars raise more serious verification problems, although, as with mobile launchers, schemes to insure adequate verification of such numerical limits can probably be defined.

In summary, it is not yet possible to make an arms limitation judgment about atmospheric intercept site defense systems. While there is currently substantial technological momentum in the development of such systems, there is a distinct possibility that this momentum could be exhausted in a few years for lack of progress. Analysis of this issue in much greater detail will be required in the context of decisions about the future of the ABM Treaty.

5.2.2 Tactical Ballistic Missile Defenses

At present, there is increasing technological momentum in anti-tactical ballistic missile (ATBM) development. While the Soviet Union has apparently progressed to the point of testing an ATBM system, the technological asymmetry between the two sides is clearly not great. Because of the many targets which could be attacked by tactical ballistic missiles (troop concentrations, airfields, supply depots, ships, etc.) there is a broad application diversity for ATBM systems. On the basis of this assessment, ATBM would not at present appear to be a very suitable environment for arms limitation. Verification of ATBM limits poses somewhat more difficult problems than verification of the limits in the current ABM Treaty. (The ABM Treaty explicitly, if imprecisely, excludes ATBM systems in that it only covers systems for countering "strategic" ballistic missiles.) The extent of this difficulty increases as the hypothetical attacking ballistic missile decreases in

range and the flight regime more closely resembles that of high performance aircraft. Nevertheless, it seems likely that adequately verifiable limits could be forged for ATBM systems for use against, say, tactical ballistic missiles with ranges above 500km.

It is also possible that the United States and the Soviet Union could both conclude that ATBM limits were in their mutual interest. This might result, for example, if the technological asymmetry factor (or more precisely, the lack thereof) were dominant and both sides concluded that the outcome of an ATBM competition would, at most, provide temporary advantages and in the end represent a waste of resources.

5.2.3 Atmospheric Intercept: City/ICBM Field Defense

At present there is no technological momentum and essentially no technological asymmetry in BMD systems for atmospheric intercept at city or ICBM field range. As a consequence there is little pressure for modifying the current ABM Treaty restrictions on such systems.

5.2.4 Exo-atmospheric Intercept: City/ICBM Field Defense

There is at present little technological momentum in development of an exo-atmospheric overlay to an atmospheric site defense. There is probably some technological asymmetry favoring the United States, in light of the advanced exo-atmospheric sensor program, but the ease of developing countermeasures against such a capability makes the current technological asymmetry unimportant in view of the difficulty of developing a system effective against potential countermeasures. As a consequence, there is currently no significant pressure to modify the ABM Treaty to permit exo-atmospheric defense at city or ICBM field ranges.

5.2.5 Area Defense: Ground-Based, Capable Against Exo-penaids

The arguments against modifications to the ABM Treaty to permit area defenses are the same as those cited above for city and ICBM field range defenses. However, Soviet interest in seeking such modifications might prove greater than that of the United States because of their concern about third party threats.

5.2.6 Area Defense: Space-Based

In spite of much speculation about the future of space-based BMD systems (lasers or particle beams) the rate of progress in the development of such systems is slow and speeding it up would be extremely expensive. Both the United States and the Soviet Union have expended substantial resources to bring such systems out of the laboratory and there has been steady progress in the early development stage which currently obtains. But at present, there is little confidence that space-based BMD systems can be deployed before the year 2000, even with greatly accelerated development efforts. And, even then, if the enormous technological problems are resolved, an effective BMD system would cost hundreds of billions of dollars. Thus, this is an area potentially favorable to arms limitation (or more precisely, to the maintenance of the current ABM Treaty ban on "exotic" BMD systems).

On the other hand, laser and particle beam weapons in space form a realm of broad application diversity, which will probably stimulate activity and resource commitments for purposes other than BMD. If these development efforts are undertaken and prove successful, verifiable limits on BMD would be greatly complicated, particularly if deployment of space-based air defense and/or ASAT were allowed to proceed. Even so, adequately verifiable limits might still be possible for space based BMD systems because of the extensive testing, the relatively high orbits, and the relatively large number of stations required for effective wide area BMD coverage. In any such regime, however, the BMD breakout potential would be great.

See section 5.4 on exotic air defense systems and 5.5 on space warfare for further discussion of potential arms control regimes for space based weapons.

5.3 OFFENSIVE NUCLEAR STRIKE SYSTEMS (TABLE 4.2)

5.3.1 Advanced IC/IR/SLBMs, Very High Accuracy

Ballistic missile accuracy represents an area of technology in which there is substantial technological momentum and very little technological asymmetry. The effort to improve ballistic missile accuracy has been one of continued success in both the United States and the Soviet Union. The issue of whether ballistic missiles could achieve yield-accuracy combinations sufficient to destroy hardened targets is no longer a matter of debate -- it is a reality. At the present time, this technology has progressed to the point where there is virtually no prospect that arms limitation could inhibit the development and deployment of missiles with accuracies on the order of, say 0.05-0.1 nmi. With such accuracies, warheads available in large numbers on current ballistic missile systems are sufficient to insure high kill probabilities (P_ks) against hardened missile silos, hardened command centers and shelters such as those currently contemplated for the MX mobile ICBM system.

A separable issue is the potential utility of arms limitation in inhibiting development and deployment of ballistic missile systems with near-zero CEPs. Such accuracies are of potential interest for non-nuclear kill of hardened targets or the destruction of very hard targets by very small yield (e.g. less than 50kt) warheads. Interest in the latter might obtain, for example, in the context of a MX shelter/Soviet ICBM fractionation competition.

An examination of the various technologies which would contribute to achieving near-zero CEP ballistic missile accuracies reveals

some potential for arms limitation inhibiting such development. It is presumed that global positioning satellites (GPS) would be available for removing all boost phase errors and that it would not be possible (and probably not desirable) to inhibit the deployment of GPS systems. This leaves the reentry phase, where the achievement of near-zero CEPs would be dependent on the availability and testing of RVs (MaRVs) with terminal homing or other reentry error correction systems. At this point in time, both types of developments could in principle be inhibited through arms control.

To date, neither the United States nor the Soviet Union has tested very small, high beta RVs. It is thus a realm with little technological momentum. By inference from the extensive testing on both sides of relatively large, high beta RVs, it is a realm of little technological asymmetry in terms of ballistic coefficients, but could be a realm of substantial technological asymmetry in terms of the ability to produce light weight, compact small yield warheads. It is a realm of some application diversity, in that highly accurate ballistic missiles could have substantial theater applications (note the emphasis on Pershing II accuracy), but this diversity could be "controlled for" in arms limitation in the sense that the difference in reentry regimes between short and long range systems does permit different limitations on each. Nevertheless, the dominant factor would appear to be the relative lack of technological momentum in the development of such systems. In an arms limitation realm in which intrusive verification measures were permitted, the independent observation of IC/IR/SLBM re-entries would permit the monitoring of a ban on testing of RVs of weight below, for example, 70kg, and ballistic coefficients above, for example, 1000 (old units). With such limitations it would be extremely difficult to develop small RVs with near-zero CEP. If deemed necessary, this type of limitation could be relaxed to apply only to long range (e.g. over 2000 km) reentry vehicles.

Inhibiting the achievement of near-zero CEPs through the use of endoatmospheric MaRVs is also potentially feasible through arms limitation. Here again, there is little technological momentum in the development of MaRV systems. While the U.S. Navy has tested an evader MaRV (the Mark 300) for possible deployment on the Trident I, to date neither side has tested an RV capable of achieving near-zero CEP and a ban on further testing of MaRVs would effectively inhibit achievement of such capability. As above, a more intrusive verification regime would be required to monitor testing of MaRVs at shorter ranges on inland test ranges. In this context, it must be assumed that any arms limitation regime that took up such limitations would include limitations on ABM systems at least as restrictive as those included in the current ABM Treaty; otherwise there would be a strong interest in maintaining the MaRV option for ABM penetration.

U.S. interest in limitations of the nature described above would be almost wholly dependent on their military utility in inhibiting threats to a multiple shelter mobile ICBM system. (A ban on MaRV testing might also stimulate some interest in deploying ICBMs in hard-rock silos on the south side of mountains.) In the absence of such a system, there would be little or no military interest in such limitations, especially since they embrace areas of technology (miniaturization of guidance systems and warheads, sophistication of guidance technology) in which the United States would appear to have a significant and sustainable advantage. At the same time, in the context of a highly restrictive ABM Treaty which negates the need for MaRVs and if, which is not obvious, the value of near-zero CEP ballistic RVs for non-nuclear kill can be discounted, the military advantage to the United States in the deployment of near-zero CEP systems is marginal. A sound argument can be made at least for a "wait and see" ban on small high beta RVs and a parallel ban on the further testing of MaRVs.

As an area in which the United States would appear to have important technological advantages, albeit not yet pursued vigorously,

the Soviet Union would probably be amenable to inhibiting the development of near-zero CEP accuracies. This would be particularly true if they had already agreed to tight limits on RV numbers through fractionation and MIRVed launcher limits.

In summary, near-zero CEP ballistic missile systems clearly constitute an area in which there is today little technological asymmetry or technological momentum. A competition in this area would probably quickly produce such an asymmetry favoring the United States, albeit one which might be of marginal military utility.

5.3.2 Advanced IC/IR/SLBMs High Penetrability vs. BMD

Efforts to improve significantly the penetrability of ballistic missiles beyond current capability could include MaRVs, exo-atmospheric and endoatmospheric penetration aids and higher fractionation levels. At present there is little technological momentum in this area of technology, but probably a significant technological asymmetry favoring the United States. The United States has already tested a broad spectrum of exo-and endo-atmospheric penaids and the Trident I evader MaRV cited above. Soviet testing of penaids has been limited, but it is clear that they could quickly develop such systems and techniques if required. As with BMD itself, there is essentially no application diversity to penaid development for long-range systems. Adequate verification of testing limitations on most penaid techniques (with the possible exception of MaRV) can be achieved through national technical means operating in the current fashion. As noted above, adaequate verification of testing limitations on MaRVs would also be possible if access to inland test ranges were available or if all test RVs carried

telemetry. However, the more important question is the desirability of such limitations.

There are three arms limitation regimes in which it is important to consider limitations on high penetrability ballistic missiles:

- o BMD limitations comparable to those of the current ABM Treaty.
- o BMD limitations much stricter than those of current treaty, so that concerns about SAM upgrade, rapid breakout, etc., are virtually eliminated.
- o BMD limitations comparable to those of the current treaty, except that extensive hard-site defense is permitted.

If there exists an ABM Treaty with limitations comparable to those in the current treaty, there will not be a significant demand for improved penetrability in ballistic missile systems. At the same time, as long as extensive BMD R&D, the deployment of anti-tactical ballistic missiles (ATBM) systems and advanced SAMs are permitted, concerns about SAM upgrade and treaty breakout will persist. To alleviate these concerns, there would be strong arguments for permitting the testing of ballistic missile systems with improved penetrability.

If BMD limitations much more restrictive than those in the current treaty were in existence (e.g. ban on BMD testing and deployment plus tight restrictions on ATBM), there would not be a strong military requirement for testing of high penetrability ballistic missile systems. At the same time there would be little or no military rationale for restrictions on such testing.

If the ABM Treaty were relaxed to permit extensive hard-site defense, a rationale for limiting improvements in penetrability could in principle exist. The argument would be one of seeking to improve the efficacy of hard-site defense through limitations on the attacking bal

listic missiles -- while at the same time not inhibiting the ability of ballistic missiles to penetrate to other targets. This is a very thin line and since an arms limitation regime which permited hard-site defense would be one where upgrade and breakout concerns would be acute, the freedom to test improved penetrability ballistic missile systems would undoubtedly be the dominant requirement.

In summary, high penetrability for ballistic missiles is a technological area in which there has been substantial earlier work, but one in which there is currently little technological momentum. This is due largely to the existence of the ABM Treaty and the confidence, on both sides, that they can easily stay ahead of advances in BMD systems based on current technology. Their ability to stay ahead of new technology BMD systems would depend on the character of the new system -- but an arms control regime which permitted the deployment of new technology BMD systems would clearly not be one in which either side would be interested in restrictions on improvements in penetrability.

5.3.3 Advanced IC/IRBM, Mobile Basing for High PLS

There have been a multitude of mobile basing schemes for ICBMs and IRBMs advanced over the past decade. To date the Soviet Union, through the SS-20 program, has been the only side to deploy a mobile system for long-range systems. However, U.S. operation of the mobile Pershing system, the nascent "scramble-on-strategic warning" GLCM deployment, and the MX program do provide the United States with some experience in this realm. It is noteworthy that there is little new, from a technology standpoint, in terms of mobile deployment schemes. This is a realm of little technological momentum and little technological asymmetry. Similarly, the applications diversity concept is not relevant since any limitation could, with proper collateral constraints, be made peculiar to ICBMs or IRBMs alone.

The various mobile ICBM schemes create different verification problems. But it is clear that intrusive inspection measures could insure adequate verification of numbers deployed (or a ban) for all of them -- and national technical means supplemented by cooperative measures would suffice for most. An additional concern with respect to some mobile ballistic missile schemes (e.g. those employing multiple shelters) is the issue of breakout potential.

In summary, mobile ballistic missiles for a long period satisfied all of the hypotheses for arms control to be attractive, as well as raising serious verification and break out problems. Nevertheless, as the strategic relationship developed in the 1970s, all of these factors were overtaken by the dominance of the strategic requirement to keep open the mobile option as a means of achieving enhanced survivability of retaliatory forces.

5.3.4 Air-Breathing Vehicles for Very High Accuracy

At the present time, there are no identifiable means of adequately verifying limitations on the accuracy of air-breathing vehicles. Even with highly intrusive on-site inspection schemes, technical information relevant to accuracy could be easily concealed. As a consequence, it is fruitless to consider any arms limitations on near-zero CEP air-breathing vehicles.

5.3.5 Air-Breathing Vehicles for High AAW Penetrability

As noted above, there is considerable incentive to develop systems which will insure high penetrability of advanced air defenses. Of these systems, the only one which appears amenable to arms limitations is the "MIRVed" cruise missile. There is no technological momentum in MIRVed cruise missile deployment (and never has been on either side)

because simple proliferation of cruise missile numbers seems a far better way to achieve high confidence penetration and greater target coverage. A time may come when the pressures for limits on cruise missiles numbers leads to much tighter limits than, for example, those in the proposed SALT II Treaty (an average of 28 ALCMs per aircraft). In such a situation, MIRVing of cruise missiles could in principle provide an outlet for achieving high penetration (e.g. of terminal defenses) and greater target coverage.

Since MIRVed cruise missiles would require substantial testing, intrusive verification measures which permitted access to cruise missile test ranges would presumably permit adequate verification of a ban on such systems. By contrast, numerical limits on them would create insuperable verification problems.

Because of continued concerns about penetrating Soviet air defenses, the United States at present would in principle want to maintain the option to develop MIRVed cruise missiles. However, there is little interest in this route for enhanced penetration. Proliferation of cruise missile numbers looks much more attractive, in part because of the need to penetrate challenging barrier defenses where proliferation of numbers to saturate the defense looks far the most dependable technique (cf. the comparable case of the choice of MIRV versus other penetration aids for ballistic missiles).

In summary, the lack of technological momentum and technological asymmetry make a ban on MIRVed cruise missiles an acceptable arms limitation option, though one with little impact on U.S. procurement policy or the strategic relationship. In contrast to the situation with mobile ballistic missiles, there is no "only route available" factor in terms of assuring penetration of air defenses. Thus a prohibition of MIRVed cruise missiles for some non-military or bargaining reason (as was the case in SALT II) would be of little concern because of the marginal interest in such systems.

5.4 AIR DEFENSES (TABLE 4.3)

5.4.1 Advanced Nationwide Defense System, Including Look-down/Shoot-down

As noted above, the components of an advanced nationwide air defense system would likely be AWACS aircraft supplemented by look-down/shoot-down interceptors. At present, such components are in an advanced stage of development (and some deployment), with substantial technological momentum in the technology. There would also appear to be a significant technological asymmetry favoring the United States, although it is debatable whether it can be sustained into the future. A further complication to limitations on such systems is the applications diversity. AWACS and look-down/shoot-down interceptors are being procured by the United States and its allies for theater applications, while the major near term Soviet motivation would appear to be strategic defense.

In light of the advanced state of development of these systems, limitations on the capability of advanced nationwide air defense systems could only be achieved through limitations on numbers of AWACS and numbers of look-down/shoot-down interceptors. Such limitations could, of course, dramatically reduce U.S. requirements for numbers and improved characteristics of cruise missiles and advanced aircraft. But, as was discussed in Chapter 3, the likelihood of Soviet interest in such limitations is not high.

Limitations on the numbers of AWACS aircraft and the power-aperture product for such radars would probably be adequately verifiable, especially with some provision for functionally-related observable differences such as the antenna currently carried by such aircraft. Limitations on the number of aircraft with look-down/shoot-down capability would create more difficult problems. Adequate verification of such limitations would require, as a minimum, a prohibition on testing look-down/shoot-down capability on all types of aircraft except those subject to the numerical limit.

Since AWACS and look-down/shoot-down aircraft have tactical/theater as well as strategic applications, evaluation of limitations on their numbers would require a complex net assessment involving controversial tradeoffs between numbers requirements for strategic and non-strategic applications. While this is in principle possible, it would in practice be very difficult. The United States has a strong technological lead in such systems and is exploiting this capability to bolster theater air defense capability. As a consequence, in a few years, the total number of U.S. AWACS aircraft constructed will be comparable to Soviet requirements for a nationwide air defense system -- thus creating a difficult situation in which to achieve meaningful limitations on such capability.

In summary, the technological momentum, technological asymmetry and applications diversity factors all argue against prospects for arms limitations on nationwide defenses based on AWACS and look-down/shoot-down interceptors. At the same time, the desire for enhancing penetrability of U.S. retaliatory forces (in this case, bombers) will create an incentive for taking on this challenge and seeking some leverage, probably in a different area, which might persuade the Soviets to agree to some limitations -- albeit with little optimism for success.

5.4.2 Advanced Battlefield/Key Installation Defense

This is an area of substantial traditional interest and sustained technological momentum on both sides. While the U.S. Patriot system reflects some technological asymmetry, it is modest and in practice mitigated by the numbers and diversity of older systems.

Since neither side has as yet deployed significant numbers of advanced SAM defenses, numerical limitations on such systems are in principle possible. Such systems tend to have many unique characteristics, so that adequate verification of numbers via NTM is potentially

achievable, though difficult because of the systems' mobility. Geographical/numerical limitations, e.g. a ban on SAM defenses of ICBM silos, are also in principle possible, albeit subject to some weakness because of the breakout problem and SAM mobility.

The military value to the United States of such limitations would not be great. This is an example of an area that is in a relatively advanced stage of technological maturity with very large numbers of earlier generation systems deployed -- not a propitious environment for useful arms limitation.

5.4.3 Advanced Fleet Air Defense Systems

It is inconceivable that the United States will develop any interest in limiting fleet air defenses for the foreseeable future.

5.4.4 Exotic Kill Mechanisms for Air Defenses

As noted in the discussion of space-based ABM systems, in spite of substantial time and effort, there has to date been only modest progress toward achieving exotic (laser and particle beam) systems of practical military utility. Thus this is not an area of great technological momentum, nor is it likely to be one in which there is any significant technological asymmetry. Nevertheless, the breadth of the applications diversity for this technology insures that it will receive substantial support for the foreseeable future.

Since exotic air defense systems have not yet reached the stage of significant testing, adequately verifiable arms limitation on such systems is in principle possible -- provided highly intrusive on-site inspection at test ranges were provided for.

The idea of limitations on exotic air defenses presents the United States with a difficult choice between enhancing bomber/strategic cruise missile penetration and achieving improved fleet and CONUS

air defense. This dilemma cuts accross both service lines and the strategic/tactical line. Exotic systems of this character also introduce a new factor, in that they represent one of the most challenging and unusual areas of scientific exploration. The technology of directed energy systems is a new frontier, which would attract substantial interest even if there were no immediate military payoff. The unusual character of such systems and the breadth of their application also makes a net assessment of such technology extraordinarily difficult.

5.5 SPACE WARFARE SYSTEMS (TABLE 4.4)

5.5.1 ASAT Missiles, Ground/Air-Launched

At present there is a modest but significant technological momentum in the development of ASAT systems. Whereas the United States at one time consciously avoided such systems, the inability to achieve an ASAT agreement and the continued Soviet testing of their low altitude system has led to a desire to eliminate the current technological asymmetry in such systems. Since the asymmetry is in reality a systems application asymmetry, not a technology asymmetry, it could readily be eliminated. At the same time, the momentum may fade from ASAT development as both sides question the desirability of unleashing such a competition.

Since the Soviets did test their low altitude, ground-launched ASAT missiles extensively, a prohibition on their further testing would only have utility after the restriction was in effect for several years. A prohibition on air-launched ASAT missiles would be of greater impact because of the absence to date of extensive testing of such systems, but would asymmetrically affect the preferred U.S. line of approach to ASAT development.

The distinct U.S. advantage in the exploitation of space for military purposes argues for limits on ASAT systems (though with some qualifications, such as the Navy's interest in defeating Soviet ocean

surveillance satellites). This U.S. advantage is manifest in general space technology, miniaturization of components and the ability through the shuttle to put greater payloads in space. The Soviet Union to date has been reluctant to conclude a ban on ASAT missile systems -- probably because of its current advantage in this area. At the same time they probably recognize that this is an area in which the United States could quickly equal and soon surpass them, with consequent risk to their own increasing dependence on space-based systems.

In summary, ASAT missiles constitute an area in which neither side has as yet made significant advances in terms of a capability to operate against all types, or even large numbers, of satellites, as well as one in which there is currently no significant technological asymmetry. Nor is there likely to be, since the technical challenge is not great. Thus, this is an area in which meaningful arms limitations are conceivable and deserve a detailed net assessment in terms of U.S. strategic objectives.

5.5.2 ASAT Space Mines

Because the technology required is comparable to that used for many benign space maneuvers, there is no apparent method for verifying a ban on the testing or deployment of ASAT mines. While the actual deployment of space mines could in principle be banned, the problems of definition and the ease with which the effectiveness of such a ban could be undercut would make such a prohibition of little military value.

5.5.3 ASAT, Disabling by Electronic Warfare

Since electronic warfare satellites could be placed in orbit and activated only at the outbreak of hostilities, there would be no military utility to a peacetime ban on such systems.

5.5.4 ASAT, Space-Based Laser/Particle Beams

As discussed above, neither side has to date developed a space-based laser or particle beam weapon. Effective deployment of such systems is years away, even with greatly accelerated development efforts. And since the testing of space weapons will presumably be detectable, a ban on their testing and deployment of such systems, with neither side being sure which will achieve an operational capability first, the Soviets might also be attracted to a ban on these systems. This is, therefore, also an area which deserves a careful net assessment in terms of U.S. strategic objectives.

The major difficulty arises in the diversity of application of space weapons, in that a system deployed for air defense or BMD would inherently have an extremely effective ASAT capability, at least for satellites in orbits below 5000 km. This fact, plus the advanced state of development of ground-based systems, which also threaten lower orbit satellites, indicates that ASAT limits confined to high or synchronous orbit satellites should be explored in any assessment of potential ASAT arms control regimes.

5.5.5 Ground/Air-based Laser vs. Low-orbit Satellites

The same arguments given above in Section 5.5.4 hold for the mountain-top or airborne laser.

5.5.6 ASAT, Nuclear-Kill

The inability to verify warhead type in an ASAT system makes a nuclear kill ASAT subject to the same arms control considerations as a conventional kill ASAT (see Section 5.5.1 above).

5.6 ASW SYSTEMS (TABLE 4.5)

5.6.1 Introduction

There is modest but significant technological momentum in most aspects of ASW. While this momentum exists on both sides, on

virtually all aspects of ASW there currently exists a distinct technological asymmetry favoring the United States, which has had a substantial lead in this field for years -- and is likely to maintain it. At the same time, there is clear applications diversity between strategic and broad tactical applications for ASW in protecting sea lines of communication and battle groups, interdicting enemy forces, intelligence collection, etc. The sum of these factors makes ASW a realm in which U.S. security is in general unlikely to be enhanced by arms limitations (though there might be specific limitations that would be of interest for cost or other reasons) and which is, in any case, not especially propitious for arms limitation.

5.6.2 Fixed ASW Barriers

The extraordinary difficulty of detecting fixed ASW barriers, to say nothing of the definition problems, makes limitations on such systems infeasible.

5.6.3 Fixed Area Surveillance - Passive

The extraordinary difficulty of detecting passive fixed area surveillance systems makes limitations on such systems infeasible.

5.6.4 Mobile Area Surveillance Arrays

While ship-towed mobile area surveillance arrays are in principle detectable, there would be extraordinary difficulties in defining limits on such systems because of their extensive use for tactical ASW. For example, would such limits be defined in terms of number of sensors, length of array, etc.? How would verification be achieved? As a consequence, overall limits on such systems are not considered feasible. However, area restrictions on their deployment might be of interest to both sides.

5.6.5 Fixed Area Surveillance Arrays - Active

Fixed active area surveillance systems could be readily identified and their power outputs measured. As a consequence, limitations on such systems could presumably be adequately verified.

In terms of the hypotheses previously put forward, this is an area ripe for arms limitation, particularly in the form of area restrictions. Neither side would appear to have a technical advantage at present and a competition in such systems would not obviously be to the advantage of either.

5.6.6 Airborne Surveillance and ASW Weapon Systems

If ASW airplanes possessed unique functional features (FRODs), then numerical limits on them would be likely to be adequately verifiable.

At present, the United States possesses a significant advantage in numbers of ASW aircraft and ASW aircraft technology and a clear strategic interest in exploiting it, even though aircraft based sensors could constitute one of the major longer term threats to submarine survivability. The Soviets recognize the importance of ASW aircraft and would be unlikely to permit the United States a negotiated advantage in such systems. This is hardly, therefore, a propitious realm for arms limitation, even though it arguably parallels in some ways the MIRV situation of the early 1970s.

5.6.7 Satellite Detection Systems

Limitations on passive satellite surveillance systems would be impossible to monitor. Limitations on active systems (radar, laser) would be relatively easy to monitor. Because of the U.S. advantage in space, there would be strong resistance to limiting the sensors deployed in space. Nevertheless the importance of limiting the ASW

threat to SSBNs could provoke some U.S. interest in a ban on active satellite detection systems. The Soviets would be likely to resist such a proposal because of their lead in radar statellites. On the other hand, they might be persuaded to accept a ban on laser systems in orbit. In this case, in particular, there is currently no significant technological asymmetry and neither side is likely to be confident of garnering an advantage in this area.

5.6.8 SSBN Trailing Systems

Limitations on passive acoustic (or other) trailing is inherently unverifiable and thus not amenable to limitation. Limitations on active acoustic trailing should be adequately verifiable, although there could be severe problems of definition (e.g., how long a contact constitutes trailing?).

In light of the U.S. advantage in quieting and passive trailing, a prohibition on active trailing could be in the U.S. interest. With the high speed submarines available to the Soviets, if they could develop a quality active acoustic transmitter they could, in principle, actively trail U.S. SSBNs coming out of port. On the other hand, they have no assurance of achieving an advantage in this area. As a consequence, a ban on active trailing could be advantageous to both sides.

5.7 CONCLUSION

It was not possible within the scope of this study to explore in detail the various areas which yielded a case for believing that arms limitations might be both feasible, and also supportive of U.S. strategic objectives. Of the several such areas which came to light, the most promising for further analysis appeared to be space-based

weapons platforms of all kinds, large fixed active ASW arrays and near-zero CEP ballistic missile re-entry vehicles (small high beta RVs and MaRVs). Of these, the most important in terms of U.S. interests is undoubtedly that of space-based platforms for weapons and related areas (such as ground-based ASAT launchers).

APPENDIX A: SUMMARY CHRONOLOGIES OF FIVE CASE STUDIES

A.1 MIRV

- August 15, 1968: United States begins flight testing of MIRVs on MMIII and POSEIDON SLBMs. No decision on deployment had been taken yet. It was generally believed that the Soviet Union was 10 years from MIRV deployment. The first flight test of Soviet MRV on SS-9 was on August 28.
- November 17, 1969: SALT talks begin in Helsinki.
- April 1970: United States develops several SALT option packages to present to the Soviets. One involved an ABM ban or limit to one site and a MIRV test and deployment ban conditional on on-site inspection. U.S.S.R. rejects U.S. proposal as "not serious". A Soviet counterproposal -- a MIRV production/deployment ban with no on-site inspection -- is rejected by the United States.
- May 1972: SALT I agreement is signed with no limitation on MIRVs.
- August 1973: U.S.S.R. begins flight testing MIRV.
- June 1979: Proposed SALT II agreement imposed limits on numbers of MIRVed launchers/warhead fractionation.

A.2 ABM

- 1958-60: Army begins ballistic missile defense program, NIKE-ZEUS
- 1960-62: Following new ABM penetration studies NIKE-X concept emerged.
- 1964: Soviet GALOSH system deployment under way around Moscow.
- January 1967: At White House meeting with President, Secretary of Defense, JCS, all past and current special assistants to the President for Science and Technology and Directors of Defense Research and Engineering concurred that ABM defense against projected Soviet threat was impossible.
- Late 1967: Scretary McNamara announces plans for light anti-China ABM SENTINEL.
- By late 1960s: Soviet program seen to be proceeding only in fits and starts; it was generally agreed that the Soviets only deployed an area ABM around Moscow similar to the NIKE-ZEUS.
- 1969: Nixon Administration announces modified ABM program, SAFEGUARD: approved by Senate by 1 vote margin.
- 1969-1972: SALT I negotiations on ABM, culminating in treaty limiting ABM to two sites for each country and 100 launchers at each site.
- 1974: Vladivostok Accord amends ABM Treaty to limit each side to one site (either an ICBM field or NCA).
- 1975: Congressional insistence leads to unilateral U.S. decision to scrap even the one site it was entitled to.
- 1980: Moscow ABM system still comprised of only 64 launchers.
- Soviet ABM R&D apparently continues at relatively higher level than that in the United States.

A.3 CRUISE MISSILES

- 1950s: Several early cruise missile programs underway in U.S. Each sufferred from severe technical handicaps which made them particularly vulnerable to enemy air defenses. By 1968, U.S. missile R&D shifted to ballistic missile technologies.

- 1967: A bomber penetration study yielded the concept of a subsonic cruise armed decoy (SCAD). The small fan jet engine and TERCOM guidance system necessary to its development were already tested and proved a year earlier. At the same time, the successful use of RPVs in Vietnam resulted in the emergence of highly sophisticated, relatively inexpensive drone aircraft.

- 1969: By summertime, SCAD had become a conceptually well-defined program. But it was viewed by the Air Force as a probable competitor to a new manned bomber. The Air Force consequently remained uninterested.

- 1971: Air Force opposition ensured cancellation of SCAD during DSARC I.

- Summer, 1972: SALT I is signed. Cruise missiles are ignored as an issue. Following the cancellation of SAFEGUARD, Defense Secretary Laird decided to initiate a cruise missile development program in the context of post SALT I force posture planning. With the incentive of a possible CM submarine, the Navy took on CM development and emerged with TOMAHAWK.

- May 1972-January 1974: Although service interest during this period remained low key, Kissinger began to support CM development as a "bargaining chip" at SALT.

- 1974: The Vladivostok Accords did not address control of CM.

- 1977: President Carter chooses an ALCM program in preference to B-1 deployment.

- 1979: After prolonged and frustrating negotiations, proposed SALT I agreements signed which impose quantitative limits on ALCMs and postpone any GLCM or SLCM deployments until 1982 at the earliest.

A.4 EUROPEAN THEATER ARMS LIMITATION

- o Idea of European theater arms limitation dates back to 1950s
  - persistent Soviet interest in limiting U.S. theater nuclear forces as well as manpower.
- o On Western side, interest became serious in late 1960s: Reykjavik Communique, MBFR Explorer Proposal, Mansfield Resolutions.
- o Western MBFR preparations heavily oriented towards manpower
  - only exception: "most threatening elements" concept, notably Soviet tanks.
- o October 1973: MBFR negotiations open
  - both sides table manpower-oriented proposals
  - Western proposal includes Soviet tank reductions, no Western equipment reductions.
- o December 1975: "Option 3" proposed by NATO
  - designed to "buy" asymmetrical manpower reductions as well as Soviet tank withdrawals.
- o May 1977: U.S.-sponsored proposal for NATO 3% budget increases in real terms and for long-range defense programs.
- o August 1977: ERW issue breaks into open.
- o April 1978: ERW deployment deferred, pending evidence of restraint by Soviets.
- o October 1979: Brezhnev announcement on unilateral withdrawal of 20,000 troops, 1,000 tanks from Eastern Europe.
- o December 1979: NATO decides to eliminate all equipment elements from Western MBFR negotiating position, including Option 3, to deploy new LRTNF and to make LRTNF negotiating proposal in SALT context.
- o October 1980: Preliminary U.S./Soviet contacts on LRTNF arms limitation.
- o By Summer 1981: Little sign of early, substantial progress in MBFR negotiations. Resumed U.S./Soviet contacts on LRTNF arms limitation expected in Fall/Winter.

A-5 CW

- o 1925 Geneva Protocol:
  - prohibition of use of gas/bacteriological methods of warfare
  - many parties retained right to retaliatory use.
- o 1972 BW Convention:
  - ban of development/production/stockpiling/acquisition/retention of bacteriological and toxin weapons
  - affirmed "recognized objective" of effective prohibition of chemical weapons
  - committed parties to negotiate for "early agreement on effective measures" for prohibition of development/production/stockpiling/destruction of existing stockpiles of CW agents and on measures concerning equipment/means of delivery for production/use of chemical agents for weapons purposes.
- o No substantial progress in negotiations
  - bilateral U.S./Soviet discussions since 1974 have not yet yielded joint draft treaty.
- o New U.S. procurement stalled during same period
  - efforts to secure binary agent production facility unsuccessful until FY1981.
- o Soviet CW posture and procurement policy ill-understood
  - intelligence hard to evaluate
    - -- difficulty of distinguishing offensive/defensive preparations
  - Afghanistan incidents.

APPENDIX B:

ARMS LIMITATION WINDOWS IN THE FIVE CASES

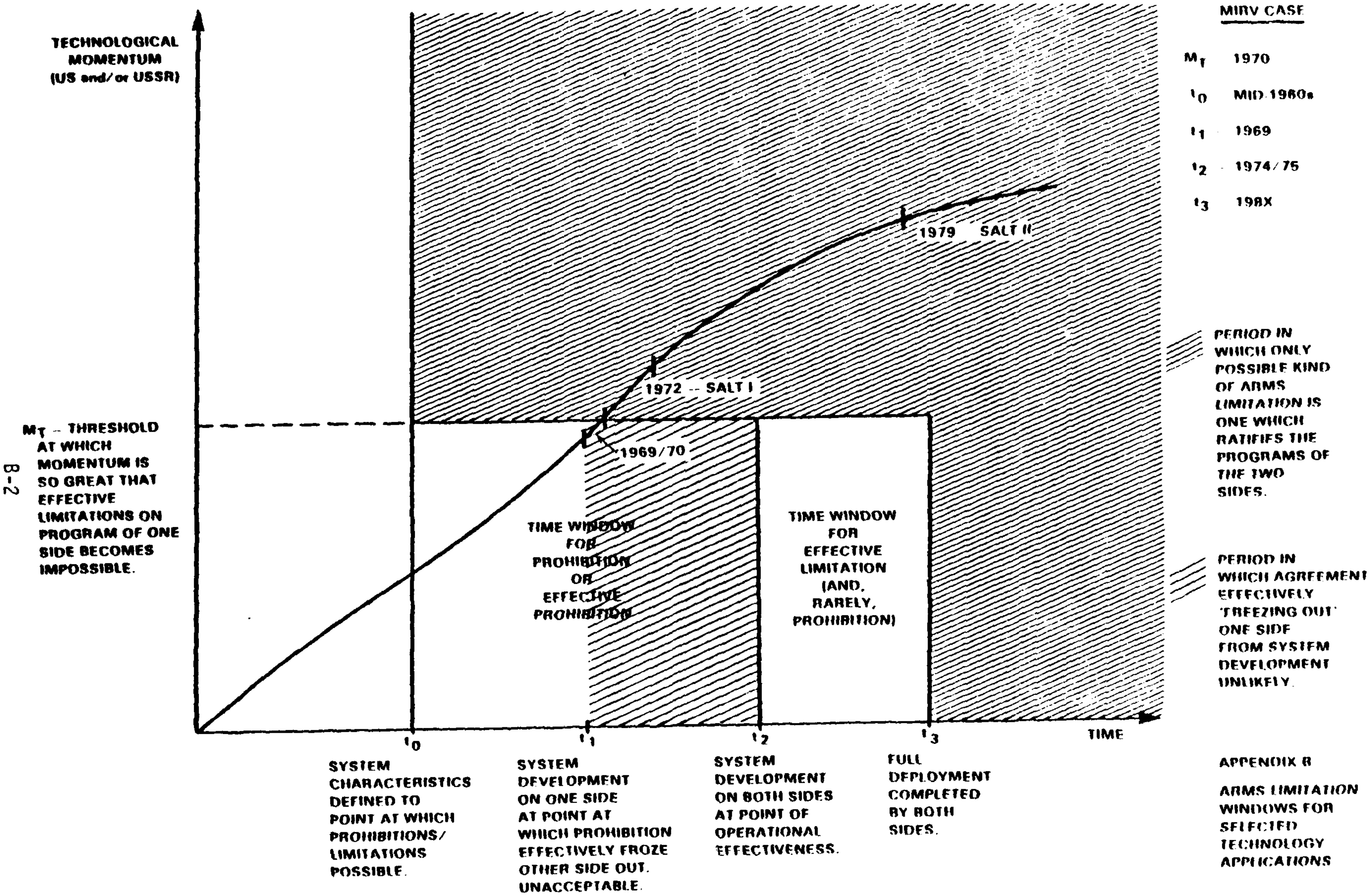

FIGURE B.1. TIME WINDOWS FOR ARMS LIMITATIONS INVOLVING PROHIBITIONS, EFFECTIVE PROHIBITIONS AND EFFECTIVE LIMITATIONS: MIRV CASE

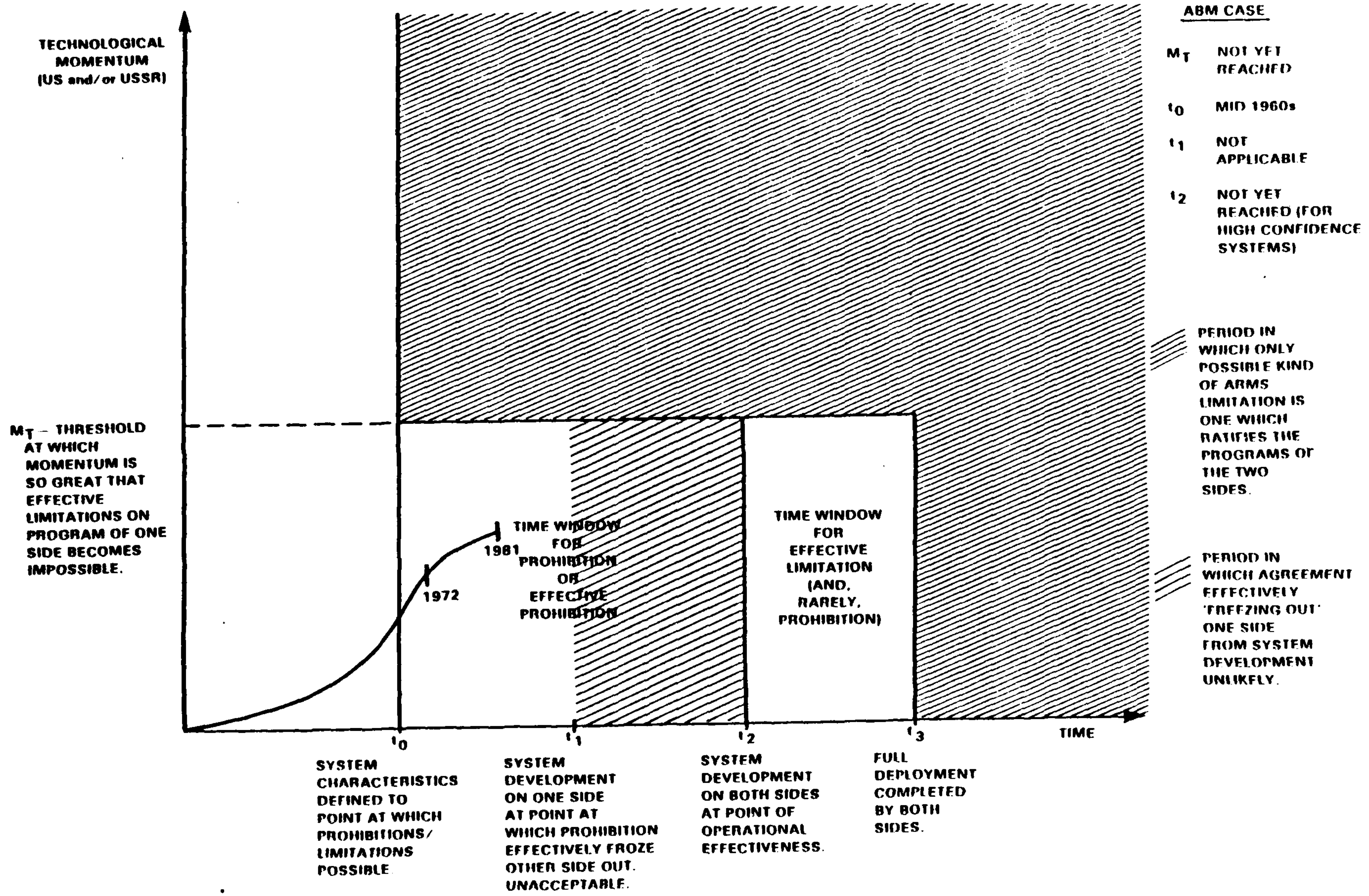

FIGURE B.2. TIME WINDOWS FOR ARMS LIMITATIONS INVOLVING PROHIBITIONS, EFFECTIVE PROHIBITIONS AND EFFECTIVE LIMITATIONS: ABM CASE

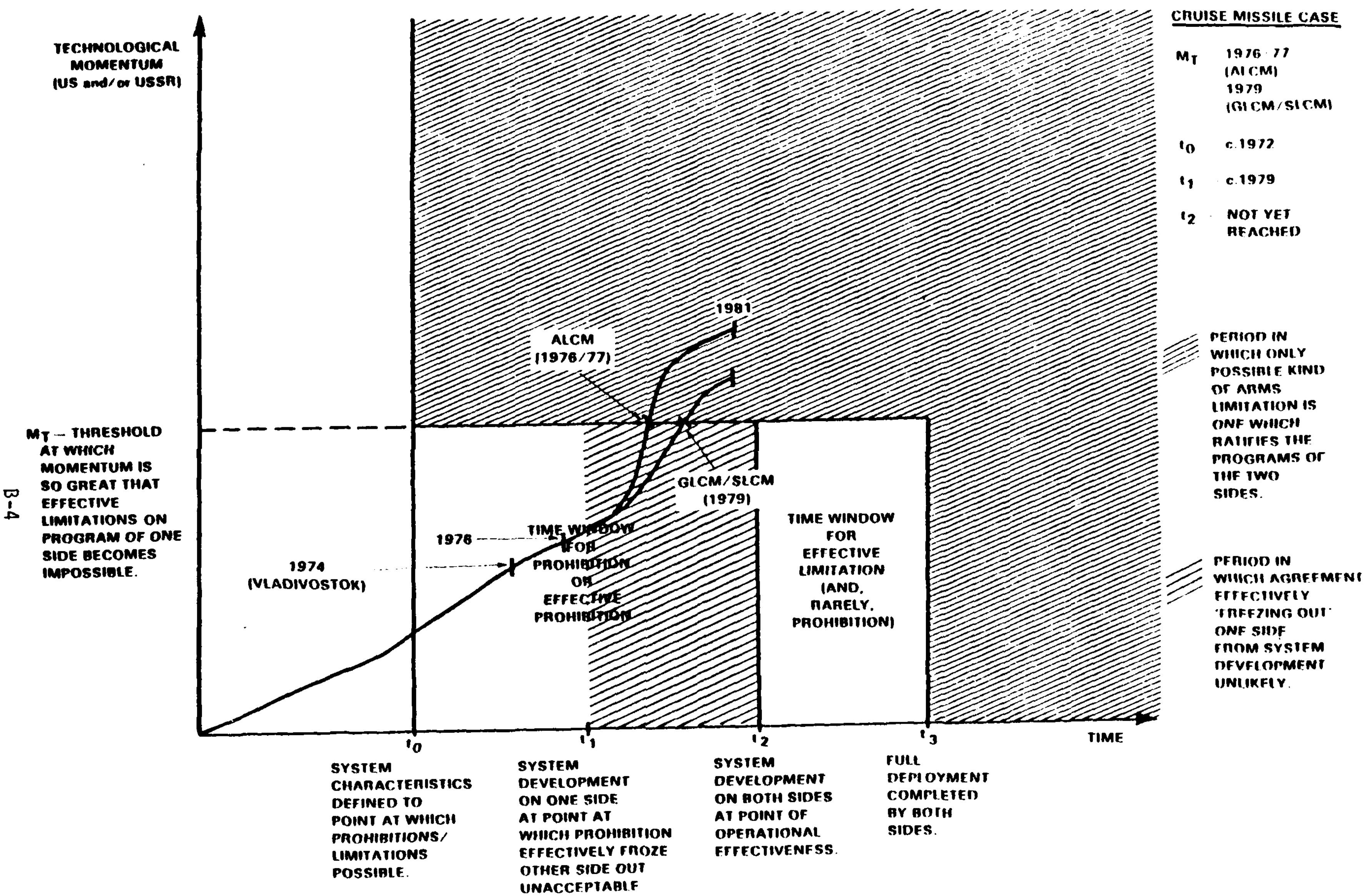

FIGURE B.3. TIME WINDOWS FOR ARMS LIMITATIONS INVOLVING PROHIBITIONS, EFFECTIVE PROHIBITIONS AND EFFECTIVE LIMITATIONS: CRUISE MISSILE CASE

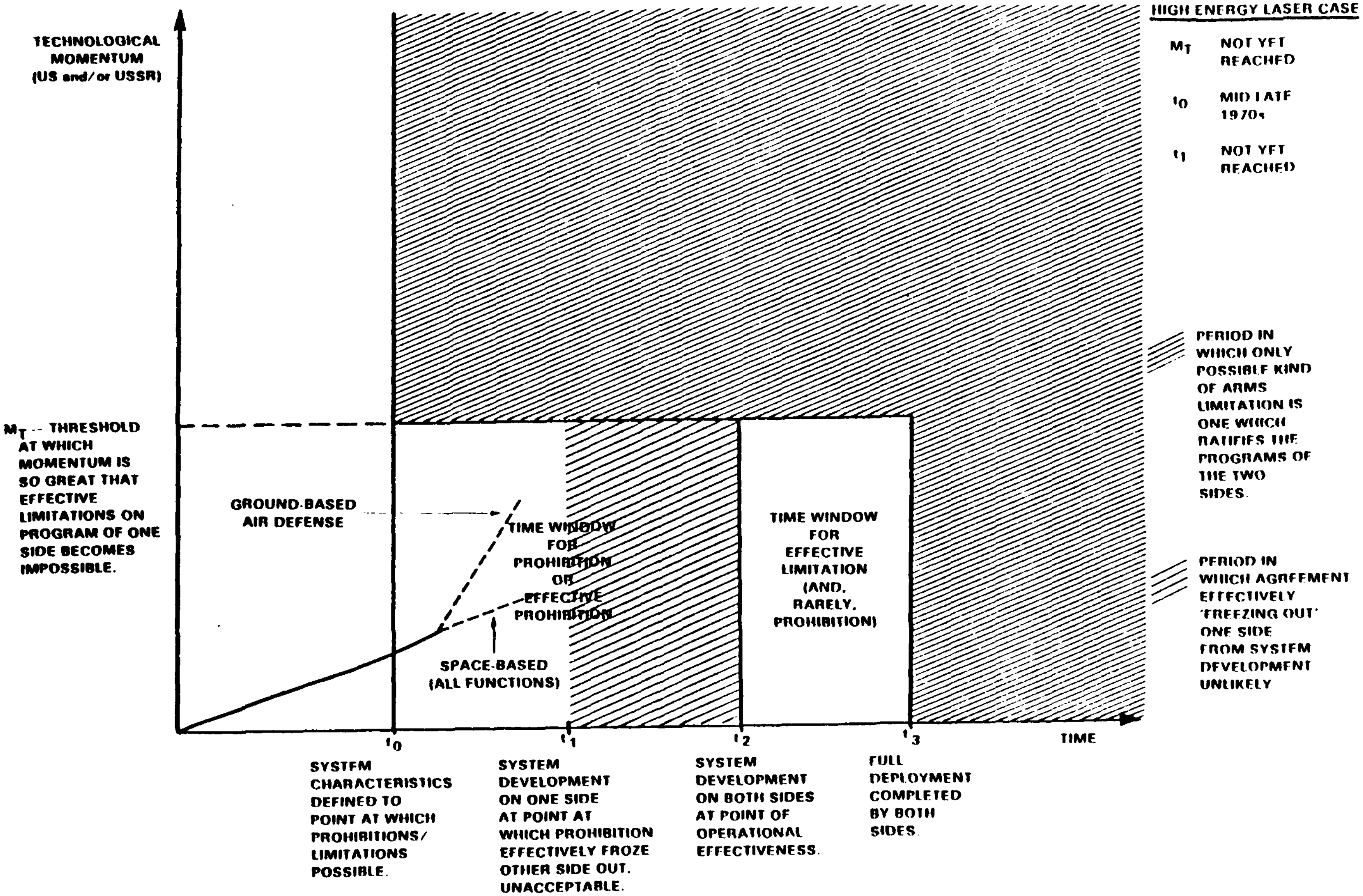

FIGURE B.4. TIME WINDOWS FOR ARMS LIMITATIONS INVOLVING PROHIBITIONS, EFFECTIVE PROHIBITIONS AND EFFECTIVE LIMITATIONS: HIGH ENERGY LASER CASE